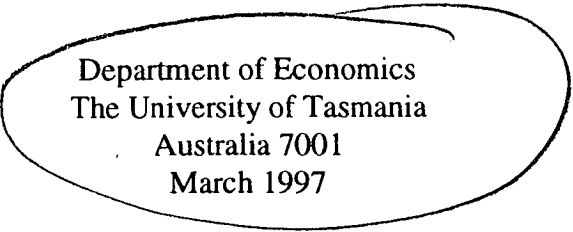


The Specifications and Testing of Structure-Conduct-Performance Relationships in Australian Manufacturing

by

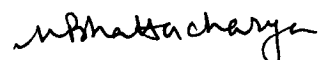
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A thesis submitted for the Degree of
DOCTOR OF PHILOSOPHY



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March 1997

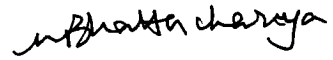
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Madhumita Bhattacharya

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Abstract

Beginning with Mason (1939) and then continuing perforce with Bain (1956 and 1968) into the early 1970s, research in the mainstream of industrial organisation (IO) was dominated by the structure-conduct-performance paradigm. The paradigm relates an industry's structural characteristics to the conduct patterns of its constituent firms, which determines an industry's performance. Specification of the relationships in this area is often largely *ad hoc* and its testing is subject to a number of difficulties.

Considering an equilibrium oligopoly framework, mainly based on Cowling and Waterson (1976) study, the thesis derives short-run equilibrium profit, concentration and industry conjectures models. The empirical analysis will consist of two parts.

Firstly, the above three equilibrium models are tested with different versions both in linear and logarithmic functional forms. Empirical testings includes testing the major criticisms against structure-conduct-performance studies with the profit model, distinguishing consumer-producer goods in explaining the structure-performance relationships and comparison of the hypothesised models with *ad hoc* versions of profits and concentration.

The profit model includes concentration, elasticity of demand, conjectures, product differentiation dummy, import intensity and capital intensity as explanatory variables. Concentration is determined by number of firms, elasticity of demand, product differentiation dummy, cost disadvantage ratio of small firms and conjectures. Industry conjectures is determined by levels and stability of concentration, growth in sales, product differentiation and import intensity. For each model, both linear and logarithmic functional forms (with some intermediate stages) are tested for empirical purposes.

For the equilibrium profit model, oligopolistic structural and behavioural variables, viz. concentration, conjectures, elasticity of demand and capital intensity are found to be significant in most of the cases. For the equilibrium concentration model, number of firms,

elasticity of demand and cost disadvantage ratio of small firms are found to be significant in most cases. For the equilibrium conjectures model, none of the above factors, viz. levels and stability of concentration, growth in sales, product differentiation and import intensity is found to be significant in explaining conjectures.

The empirical analysis deals with testing the importance of major criticisms against the structure-conduct-performance studies in explaining the relationships. These criticisms are: i) omission of the relevant explanatory variables, ii) measurement error in the variables, and iii) aggregation bias and iv) existence of simultaneous causality among variables and v) mis-specification of the functional form of the model. These are tested with the profit models.

The first three criticisms, viz. errors of omitting relevant variables, measurement error and aggregation bias are tested with the profit model. Resulting estimates suggest the importance of dealing with each of these issues in explaining the structure-performance relationship.

The existence of simultaneous relationships among the variables is tested with two systems of equations. The first system of equations consists of equilibrium profit, concentration and conjectures models. The second system of equations consists of disequilibrium profit and concentration models and the equilibrium conjectures model. Profits, concentration and conjectures among firms are treated as endogenous variables. For both systems, the empirical findings support there is a simultaneous relationship between the profit and concentration equation.

The second system of equations deals with the existence of sub-optimal behaviour. This is done by specifying disequilibrium models separately for profit and concentration. Partial adjustment model is considered with a constant rate of adjustment towards the equilibrium level, assuming that any deviation from equilibrium is corrected at the constant rate of adjustment. For the profit model, the signs of coefficients of the disequilibrium version are found to be same as the equilibrium model with a significant positive sign for

initial profit. Also for the concentration model, the signs of the coefficients of the disequilibrium version are found to be same as the equilibrium model with a significant positive sign for initial concentration. The annual adjustment rate of profit and concentration are both found to be slow.

For the equilibrium profit, concentration and conjectures models, empirical analysis is carried out against a sample of 102 Australian manufacturing industries at the Australian Standard Industrial Classification (ASIC) at the four-digit level data for 1984/85. For the disequilibrium profit and concentration model, the data are used for two periods (1977/78 and 1984/85), with a seven year lag for the above industries.

CHAPTER 1

INTRODUCTION

1.1 General Introduction

The structure-conduct-performance (SCP) paradigm has played an important role in industrial organisation research since the pioneering work of Mason (1939). He and his colleagues examine in depth the relationships between various structure and performance variables for a large number of industries. The basic idea is that market structure determines the conduct (strategy) of firms which in turn determines the performance of industries. Exogenous basic conditions determine market structure and a unidirectional causality exists from structure through conduct, to performance. In most cases, a positive relationship is found between profit (an index of performance) and concentration (an index of structure). The majority of these studies are based on the economies of the U.K., U.S. and Canada.

In Australia, comparative industry studies are relatively few. In a paper, Round (1974) has mentioned,

" It seems quite safe to conclude that, as far as can be ascertained on the basis of published research in the form of journal articles, Australia has indeed experienced a comparative vacuum in industrial organisation." (1974, p 178)

The few Australian cross-section studies relating industry concentration and margins have not established a significant and robust positive relationship between concentration and profits. This study specifies and tests various structure-conduct-performance relationships for Australian manufacturing.

In this introductory chapter, section 1.2 provides the basic framework within which most empirical studies take place in this area. Section 1.3 presents the objective of the study. Finally, the outline of the study is considered in section 1.4.

1.2 Basic Framework: The Structure-Conduct-Performance (SCP) Paradigm

The structure-conduct-performance paradigm is the basis for extensive cross-sectional empirical work in industrial economics. Market structure refers to a description of a market in terms of the number and the size distribution of the firms and any entry barriers arising from the technology of production. Market structure depends on the basic conditions of demand and supply. Demand conditions include direct and cross elasticity of demand, market growth and the purchasing power of the customers. Supply conditions include location and ownership of raw material, technology, unionisation, product durability, industry history and the legal, ethical and political framework within which business activities take place. Under the heading of market structure the following characteristics can be listed: concentration, diversification, product differentiation, barriers to entry and scale economies.

Firm conduct includes the decision of firms on pricing, the way in which the volume, quality and range of products are determined, research and development planning, implementation and legal tactics, the decision by the firms whether to collude or compete. One effect of the conduct may be to change the industry structure in terms of the market concentration or entry barriers. However, the main importance of conduct is that it provides the link between structure and performance.

Industry performance in its most general sense is an evaluation of the contribution of the industry as a whole to economic welfare. A typical list of performance indicators include allocative efficiency, equity, employment creation, X-efficiency, technological progressiveness and quality of output. In practical terms, performance refers primarily to profitability, a measure related to allocative efficiency.

In this structure-conduct-performance paradigm, traditionally, the direction of causality is from structure to conduct to performance i.e. market structure determines firm conduct which in turn influences industry performance. The estimation of market structure-performance relationships has been a major activity within the field of industrial economics for the last few decades. The conventional approach in cross-sectional studies is to find the

relationships between certain characteristics of the industry structure (e.g. concentration, barriers to entry) and measures of industry performance, particularly with respect to profitability. A structure-conduct-performance schema is shown in Figure 1.1.

1.3 The Objective

Manufacturing is a core sector in terms of employment, output, international trade and maintaining the standard of living in the Australian economy. The relative importance of the manufacturing sector has been declining since the 1970s. Over the last two and half decades, the economy has experienced major structural adjustment with emphasis on changes in output and employment of the major sectors in the economy. The key objectives of government industry policies in this respect are to improve efficiency and international competitiveness in the manufacturing sector in the economy.

Major characteristics of the Australian economy are its isolation and small domestic fragmented market. Most of the industries are led by two or three large firms with high concentration and there are both natural and artificial trade barriers. Due to its geographic isolation from the rest of the world, transport costs are quite high. High level of concentration with the presence of anti-competitive practices (before 1974) are quite common and restrain efficiency of domestic firms.¹

Research in the mainstream of industrial organisation has tested the relationship between profit rates (an index of performance) and concentration (an index of structure), including other variables (e.g. capital intensity, advertising intensity, growth, measures for barriers to entry, import and export intensity). Whilst overseas literature shows a tendency for profitability and concentration to be positively (if weakly) associated, Australian results are rather mixed. In most of the Australian studies, a significant positive relationship is not found between these two variables.

Specification of the models for most of the structure-conduct-performance studies (both for overseas and Australia) has been largely *ad hoc* and subject to a number of

¹Detailed discussion is in Chapter 3.

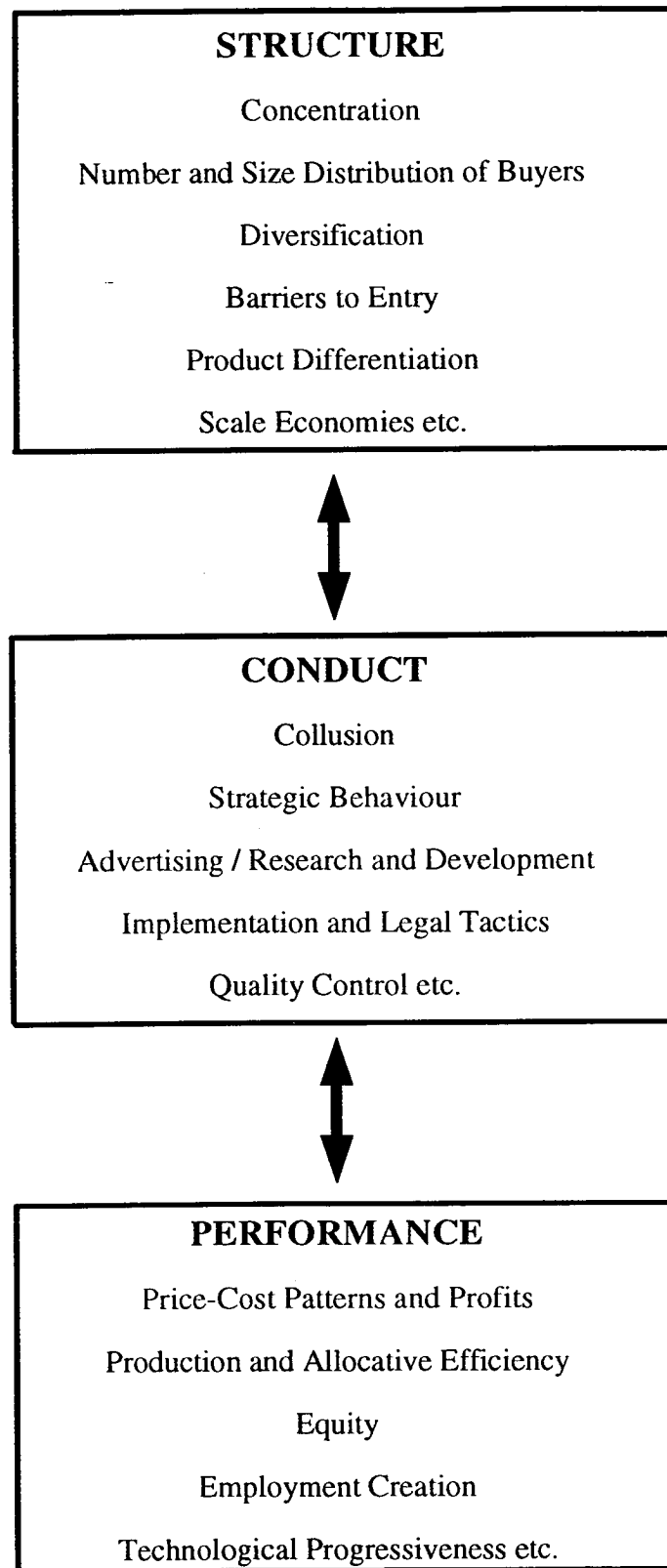


Figure 1.1: The Interactive Structure-Conduct-Performance Relationships

conceptual difficulties. According to Parry (1978), the structure-conduct-performance relationships can best be explained with an oligopoly framework for a small open economy like Australia. In this study models are developed from oligopoly theory to explain the structure-conduct-performance relationships.

To specify a structure-performance relationship with other control variables the major criticisms against earlier studies should be considered. These are: i) omission of the relevant explanatory variables; ii) problems related to the measurement of variables; iii) problems with the use of aggregated data sets; iv) estimation problems due to the simultaneous causality among variables and v) mis-specification of the functional form of the model. The structure-performance relationship may be affected due to any of the above factors. The importance of each criticism is considered in explaining industry profits.

Keeping the above points in mind, the specification of the relationships (among the structure, conduct and performance variables) are developed in the study with the help of oligopoly models from standard literature. The empirical work consists of following steps:

Firstly, simple short-run equilibrium models are specified with the determinants for each focus variable, viz. price-cost margins, concentration and conjectures. Estimations of the models include all possible versions. Also some major issues dealt with in the structure-conduct-performance studies are examined with the final version of each model.

Secondly, disequilibrium versions of both the profit and concentration models are specified with the help of the partial adjustment models. The estimated annual rate of adjustment of profits and concentration are calculated for the seven year period, 1977/78 to 1984/85.

Finally, estimation of the models as a simultaneous equation system examines the simultaneity (if any) that exists among variables.

In the last section, a brief outline of the study is presented by giving an indication of the contents of each chapter.

1.4 Outline of the Study

The presentation of the chapters is as follows. Chapter 2 provides the basic framework of the study. In this respect, a literature review of the overseas as well as Australian studies based on the structure-conduct-performance paradigm is presented.² Also the major criticisms against these studies are identified.

In Chapter 3, an overview of the Australian manufacturing sector is presented. Firstly, a discussion on the role of manufacturing sector in the Australian economy in terms of output, employment and trade performance is given. The period between 1970/71 and 1986/87 is covered for the discussion.³ Secondly, major characteristics of the Australian manufacturing sector are identified with some recent structural adjustments.

Chapters 4 and 5 present the analytical framework adopted in the study and specify the models. In Chapter 4, firstly, a short-run equilibrium model of profit is developed theoretically following Cowling and Waterson (1976), that explicitly incorporates industry elasticity of demand and conjectures. Extensions to the equilibrium profit model include openness and heterogeneity of products. Secondly, disequilibrium versions of the profit model are specified, including partial adjustment of profits towards the equilibrium level. For both the equilibrium and disequilibrium models, linear and logarithmic functional forms are considered.

Chapter 5 specifies the concentration models (with different versions) and a model of conjectures with some structural determinants. After some literature review, the short-run equilibrium model of concentration model with different versions are developed. A discussion on the empirical studies explaining 'changes in concentration' is included. In this respect, disequilibrium versions of the concentration model are specified, including partial adjustment of concentration towards the equilibrium level. After reviewing the literature on the oligopolistic interdependence among firms (or conjecturess) in terms of traditional theory and game theory, a model of conjectures is specified with some structural determinants. Both for

²Here, the structure-conduct-performance studies are covered from a general view point. The specific literature is reviewed along with the specification of each model given in Chapters 4 and 5.

³ This is mainly because the data set for empirical analysis covers 1977/78 to 1984/85. The study focuses on the period between late 1970s and mid 1980s approximately.

concentration and conjectures, the linear and logarithmic functional forms are specified for empirical purposes.⁴

Chapter 6 defines the variables of the models developed in Chapters 4 and 5. The data base is described in detail. Here, 102 manufacturing industries are considered at the Australian Standard Industrial Classification (ASIC) four-digit level for empirical analysis. The description of the industries is in Appendix II. The data generally refer to only one period in time, predominantly the 1984/85 period, although for disequilibrium versions, the data for 1977/78 financial year are used.⁵ Finally, the econometric procedures and diagnostic testings used are described. For estimation an econometrics package, SHAZAM (1993), Version 7.0 is used.

Chapter 7 presents the findings from the profit model with different versions. Firstly, for the short-run equilibrium profit model, both the linear and logarithmic functional forms are considered. Both theoretically and empirically (at least in terms of signs and significance) the logarithmic functional form is found to be superior. Secondly, the major criticisms against the structure-conduct-performance studies in explaining the profit-concentration relationship are examined with the logarithmic functional form of the profit model. Thirdly, a few issues, viz. how the presence of i) aggregation bias (if any) in the data set and ii) consumer/producer goods industries may affect the profit-concentration relationship are examined with the profit model of the logarithmic functional form. Also, an *ad hoc* version of the profit model is considered here and the results from this model are compared with the oligopoly based profit model. Finally, findings from the disequilibrium versions of the profit model are presented with estimates of the annual adjustment rate of profit for a seven year period.

Chapter 8 presents the findings of the concentration model and a version of industry conjectures model. Firstly, for short-run equilibrium versions of the concentration model, both linear and logarithmic functional forms are specified. Secondly, the findings from the disequilibrium versions of the concentration model are presented with the annual adjustment

⁴ Although, theoretically, logarithmic specification is appropriate for the profit and concentration model, linear specification is considered for the profit, concentration and conjecture model to compare the findings from other studies.

⁵ The selection of period is predominantly due to the availability of funding to purchase this unpublished data series. The cost was A\$9000 from the Australian Bureau of Statistics (ABS).

rate of concentration for the seven year period. Finally, a discussion on the empirical findings from the hypothesised model of industry conjectures is presented for both the linear and logarithmic functional forms.

Chapter 9 examines the interdependence among the structure-conduct-performance variables. Two systems of equations are considered here. System I includes three equilibrium models of profit, concentration and conjectures, while System II includes disequilibrium models of profit, concentration and an equilibrium version of industry conjectures model.

Finally, Chapter 10 summarises the major findings with possible policy implications. The limitations of the study are mentioned here with some directions towards future research in this area.

CHAPTER 2

THE STRUCTURE-CONDUCT-PERFORMANCE PARADIGM

2.1 Introduction

In industrial organisation, the most widely accepted paradigm stems from various concepts of interactions among industry structure, firm's conduct and the social and economic performance of an industry.¹ The main theme of the structure-conduct-performance paradigm is that exogenous basic conditions determine market structure and there is a unidirectional causality from market structure, through conduct, to performance.

This chapter reviews the literature in this area. In section 2.2, the central hypothesis of the structure-conduct-performance paradigm, including different interpretations is presented with some overseas evidence. A critical analysis of the existing literature is covered in section 2.3. To provide a perspective and rationale for the present study, the relevant Australian literature is discussed in section 2.4. Finally, in section 2.5, some concluding remarks are added.

2.2 The Central Hypothesis: Concentration Influences Profitability

The most frequently tested hypothesis in structure-conduct-performance theory is that profitability (an index of performance) rises with concentration (an index of structure). Almost all studies find a positive (although sometimes weak) association between these two variables. However, two different interpretations exist regarding the causality of this relationship, leading to opposite recommendations for antitrust policy.

¹ The literature developed in this area is quite voluminous, some major issues are considered here.

2.2.1 Alternative Explanations to the Profitability-Concentration Relationship

While structure-conduct-performance analysis is one of the major areas of research in Industrial Organisation, there remains different schools of thought regarding the policy implications behind a positive profit-concentration relationship.

2.2.1.1 The Market Power Argument (Differential Collusion Hypothesis)

In a competitive market, there are a substantial number of firms, with low levels of concentration. In the short-run, firms can earn positive or negative profits. In the long run, due to the absence of barriers to entry, selling prices are always equal with marginal costs. Each firm enjoys normal profit.

In an imperfect market structure, like competitive market, firms will earn positive or negative profits in the short-run.² However, firms may raise their selling price above long run marginal cost giving rise to super normal profit in the long run. The firms enjoy market power.

Table 2.1

Table 2.1: A Summary of Market Structure with Profit Outcomes

Type of Market	(P-MC) - is an index of market power	Short-Run Profit	Long-Run Profit
Competitive	0	\pm	0
Monopolistically Competitive	+	\pm	0
Monopolistic	+	\pm	+ or 0
Oligopolistic	+	\pm	+ or 0

summarises profits enjoyed by firms under different market structure both in short-run and long-run. In a homogeneous oligopolistic industry, the degree to which price exceeds marginal

² Here, mainly oligopolistic market structure is considered as this is more common in real markets.

costs depends upon the effectiveness of collusion (either explicit or tacit) among sellers. The more concentrated are the firms within an industry, the greater is the opportunity of maintaining successful collusion. Perfect collusion leads to joint monopoly price among cooperating sellers.

The traditional concentration (structuralist) doctrine is based on two fundamental concepts: Firstly, high seller concentration facilitates explicit and/or tacit collusion, leading to higher profitability for the firms.³ Secondly, the leading firms in concentrated industries tend to be larger than the minimum optimum size dictated by scale economies. The policy implication is that antitrust policies could be introduced to reduce prices without a serious loss of production efficiency.

2.2.1.2 The Efficiency Argument (Differential Efficiency Hypothesis)

Opposed to the structuralist doctrine is what has been called the efficient structure doctrine by Demsetz (1973 and 1974).⁴ He argues that the positive profit-concentration relationship is not due to the collusive behaviour of firms, but due to the efficiency of large firms. This may be due to the cost-advantages of larger firms over the rivals (e.g. in the form of the presence of scale economies/or lower marginal costs). To quote Demsetz (1974), " A phenomenon... likely to generate fairly persistent differences in accounting rates of return is the fact that some products are more efficiently produced by firms possessing a large share of the market" (1974, p 176) and he concludes, "It would appear that most, if not all, of the positive correlations between profit rates and concentration uncovered by some earlier studies can be attributed to variations in the size of firms not the degree to which markets are concentrated." (1974, p 178).

³ Stigler (1964), Saving (1970) and Cowling and Waterson (1976) support this argument. Stigler derives a relationship between the likelihood of collusion and the Herfindahl index of concentration. On the other hand, Saving expresses price-cost margin as a function of concentration ratio using a model of dominant firm price leadership. Finally, Cowling-Waterson study relates the price-cost margin to the Herfindahl index of concentration using a Cournot model of homogenous oligopoly.

⁴ Brozen (1974) and Peltzman (1977) also support Demsetz's argument.

According to the efficiency argument, policies leading to deconcentration may reduce efficiency and result in a loss of welfare.

2.2.2 Overseas Evidence on Concentration-Profitability Relationship

The positive association between concentration and profitability is established in most of the studies using U.S. data. These studies are summarised in Weiss (1974) and more recently in Scherer and Ross (1990, Chapter 11). There are a few exceptions for the U.S. studies, e.g. Stigler (1963), and Brozen (1970, 1971).

Stigler using income tax data for internal revenue service (I.R.S) minor industries, for the period 1947/54, constitutes an outstanding exception to the general conclusion. He points out that the salaries of the owner-managers of small corporations are also a part of their profit. In the unconcentrated industries, the percentage of total revenue accounted for the small corporations is higher than for the concentrated industries. The observed difference between the average profit rates between the two groups vanishes when the profit rate is adjusted for these excessive salaries.⁵

Brozen (1971) considers the same data source as Bain, with an extended sample of industries. For the extended sample of industries he can not establish any relationship between concentration and profitability.

Studies based on the U.K. data have mixed findings. Holtermann (1973) uses eight different performance indicators, with concentration, capital-output ratio, growth of industry, measures of entry barriers, advertising-intensity and investment/sales as explanatory variables. She finds a non-significant negative effect of concentration on price-cost margins.⁶

Cowling and Waterson (1976) develop a simple oligopoly equilibrium model explaining gross profit margins with concentration, elasticity of demand and firm conjectures.

⁵ Kilpatrick (1968) reports that Stigler's correction for 'entrepreneurial withdrawal' contains statistical bias. When the bias is corrected, a positive and significant relationship between concentration and profitability is established for a similar sample of industries.

⁶ In conclusions, Holtermann (1973) indicates few reasons for this negative relationships, e.g. aggregated data set, proxies for concentration and barriers to entry are poor.

For empirical purposes, to avoid the problems with omission of relevant explanatory variables, they consider inter-industry changes in the profit margin over a time period. Change in concentration (both Herfindahl index and four-firm concentration ratio) and change in unionisation are treated as independent variables. To capture the cyclical effect on equilibrium, industries are divided into durable and non-durable goods. With U.K. Minimum List Heading (MLH) data, a significant positive association is established between profit and concentration using both the full sample and sub samples.⁷

Hart and Morgan (1977), attempt to relate the effects of concentration on margins for the U.K. manufacturing sector. Using the levels of variables, a significant positive effect is found between the degree of concentration and profits. But using changes in variables, no such relationship can be established.

With a different data set for U.K. manufacturing, Clarke (1984) concludes that there is no evidence of a positive relationship between concentration and a profit variable for the period 1970/76. However, he mentions that this obscure relationship could be due to the presence of existing particular factors (e.g. the tighter controls on price for the large companies for the later part of the investigated period). This may affect the concentration-profitability relationship.

From the above discussion, it is obvious that the relationships between the structure and performance variables are complex.⁸ The strength and direction of the relationships between structure and performance variables remain open to question.

⁷ The results are stronger with Herfindahl index compared to the four-firm concentration ratio.

⁸ Clarke (1983) and Hart and Morgan (1977) suggest that sophisticated econometric technique is needed to explain the complex structure-conduct-performance relationships.

2.3 Common Criticisms against the Structure-Conduct-Performance Studies

In the following sub-sections the common criticisms against the structure-conduct-performance studies are discussed.

2.3.1 Omission of Relevant Explanatory Variables

In the absence of competition, if a relatively few firms control a large proportion of an industry's sales or assets, both in short-run and long-run firms may enjoy profits substantially above the competitive level. In this respect, the positive association between concentration and profitability (due to market power or efficiency) has received considerable attention in empirical research. However, concentration as a single explanatory variable may not explain the differences in industry profitability fully; the addition of relevant explanatory variables may affect the structure-performance relationship. For example, in their paper, Cowling and Waterson (1976) develop a profit model which includes the price elasticity of demand and firm's conjectures about rivals' responses as important determinants along with concentration.⁹ The above two determinants (viz. price elasticity of demand and firms' conjectures) are not commonly considered in the literature. They emphasise that the omission of relevant explanatory variables may lead to biased results in estimating the coefficients of the variables of interest.¹⁰ In practice, most of the models are based on *ad hoc* literature search, the problem due to the omission of relevant explanatory variables should be kept in mind in explaining results.

Also, in the earlier literature, most of the studies ignore the influence of international factors, e.g. export and import intensity. In a closed economy, the dimensions of domestic market structure (seller concentration, growth of industry demand, the conditions of entry) may be sufficient to explain profitability. However, the international trade factors may affect

⁹ Most of the studies implicitly assume market price elasticity of demand and firms' conjectures are identical for all industries. This may lead to a serious specification bias in the model.

¹⁰ Martin (1979) points out mis-specification due to the omission of relevant explanatory variables in the system of simultaneous equations can be an important problem for the identification of the simultaneous system.

industry profitability significantly in an open economy (see, Esposito and Esposito (1971) and Pagoulatos and Sorenson (1976)).

Other dimensions commonly used in literature in explaining the structure-conduct-performance relationship are barriers to entry (economies of scale, product differentiation, initial capital requirement etc.), industry growth, firm size, foreign-sector variables, e.g. export and import intensity, foreign investment and effective protection. Clearly, the factors which can explain the relationships logically should be included into the models.

2.3.2 Measurement Error

The measurement problems related to some of the important variables in the studies of market structure are considered below.

2.3.2.1 Errors of Measurement in the Dependent Variable (Profit)

Measurement error in the dependent variable may affect the structure-conduct-performance relationships. In Australia, Phillips (1978) finds a positive profit-concentration relationship considering profit measures on sales but negative with capital based measures.

In most of the studies, researchers employ return to assets or equity rather than return on sales.¹¹ In a competitive market equilibrium, with proper allowance for risk, interest and depreciation, return on asset or equity (or accounting rate of return) would be zero. In the presence of monopoly power (or superior efficiency of large firms) an above competitive rate of return emerges. The accounting profit is an imperfect surrogate for economic profit, as any income is treated as a return on asset. Monopoly profit would disappear if one capitalised the assets properly. It is expected that accounting measures of profits will misstate monopoly power.¹²

¹¹ The difference between accounting measures of profit and economic measures of profit is discussed in Chapter 4.

¹² As mentioned earlier, accounting measures of assets are not capitalised properly. Stigler (1963) argues profits of small firms are not reported properly which may cause biased relationship between profit and concentration.

For constant cost industries, the return on sales is the same as the price-cost margin, a performance variable suggested by oligopoly models, e.g. Cowling and Waterson (1976). For some studies with price-cost margin, advertising-sales ratio as well as research and development intensity variables are added as control variables. The conceptual problem here concerns whether these items should be considered as current or capital expenses, which may affect rates of return (see Comanor and Wilson (1974), Bloch (1974,1980)).

It is found that the profit-concentration relationship may differ if profit on value added are used instead of profit on sales. Profit rates on sales may be affected by excise taxes and the internal accounting procedure of vertically integrated firms. For this reason, some studies, e.g. Conyon and Machin (1991), deflate profits with value added instead of sales.

2.3.2.2 Errors of Measurement in the Explanatory Variables

Here we mainly focus on measurement error with concentration. Seller concentration is used widely as an index of market structure. It should be adjusted for open economy and for regional markets (see Utton (1982), Kumar (1985), Dixon (1988) and Phillips (1978)).

In oligopoly models, like Stigler (1964), Cowling and Waterson (1976), the Herfindahl index is preferred to the rather than concentration ratio.¹³ Additional to the theoretical relevance of choosing between these two indices, Sleuwaegen and Dehandschutter (1986) argue the 'horn-shaped' relationship between the Herfindahl index and concentration ratio may lead to a bias in the profit-concentration relationship that identifies critical concentration ratio incorrectly. Therefore, the choice of concentration measure is not trivial.¹⁴

Proxies for entry barriers, e.g. advertising intensity or minimum efficient size plant (or firm), are often measured poorly in absence of detailed cost/scale information.

¹³This index is not readily available for most of the countries, where this is used better results generally are found than with the concentration ratio.

¹⁴ This is also supported by Kwoka Jr (1981).

2.3.3 Specification Bias

Under this heading three type of problems can be included. Firstly, there are often simultaneous relationships among variables, in that case, single-equation estimation technique may yield biased results. Secondly, the studies are often mis-specified in terms of variables as mostly these are based on prior belief, not on firm economic theory and finally mis-specification may arise due to improper functional form.

2.3.3.1 Simultaneity Problem

In the structure-conduct-performance paradigm, there is a unidirectional causality between structure and performance variables. Some researchers, such as Geroski (1982) and Clarke and Davies (1982), argue that concentration and profitability are jointly determined by exogenous variables in the system. The argument can be extended for other variables, e.g. between the advertising-intensity variable and profitability; between the advertising-intensity variable and concentration; between growth and concentration; etc. In the presence of a simultaneous relationship, the single equation approach results in inconsistent and biased estimates of the relevant parameters. To capture the complex relationships among variables, a simultaneous equation approach is required.

There are considerable differences of opinion among researchers regarding the use of the simultaneous equation approach in explaining structure-conduct-performance relationships. According to one group of researchers, further effort in modelling industrial organisation relations within the framework of simultaneous equations provides more appropriate results for the structure-conduct-performance relationships.

An example of the benefits of the simultaneous equation approach is given in findings of a study by Intriligator (1978). In a six-equation simultaneous equation model, he integrates previous single equation studies. The following variables are considered as endogenous variables: the concentration ratio, the relative change in number of firms, the capital-output ratio, the advertising-sales ratio, the relative change in price and the profit rate on net worth.

Exogenous variables include minimum efficient scale, the price elasticity of demand, the income elasticity of demand, the real wage, the relative change in direct costs and the growth in the value of shipments. The results suggest a two-way relationship between some of the endogenous variables (e.g. capital-labour ratio and concentration, concentration and advertising-sales ratio, profit and concentration, and profit and advertising-sales ratio) of the model. Moreover, different results are found using the OLS (ordinary least squares) and the 2SLS (two-stage least square) estimation techniques for some of the variables (e.g. the effect of advertising on concentration, the effect of profit and concentration on advertising, and the effect of minimum efficient scale on profits).¹⁵ He concludes, "... the method of estimation does have an important effect on the estimated model, and certain of the results of previous studies using OLS are called into question." (1978, p 480)

In a different model, for the U.S. food-processing sector, Pagoulatos and Sorensen (1981) explain the inter-relationships and feedback effects among margins, concentration and advertising. Advertising has a significant effect on both margins and concentration, concentration on margins and advertising, and margins on advertising. Their results also support a simultaneous equation approach in explaining the inter-relationships among the structure-conduct-performance variables.

Gupta (1983) considers a five-equation simultaneous system for Canadian manufacturing industries. Endogenous variables are concentration, foreign ownership, advertising, sub-optimal capacity and the price-cost margin. The positive effect of concentration on the price-cost margin for the OLS result is insignificant for the 2SLS and the three-stage least squares (3SLS) estimations. For some other structural variables, he establishes different results using the OLS and the 2SLS technique. Simultaneity bias is quite influential in determining the inter-relationships among the variables.

According to another group of researchers, simultaneity bias is not important. They find simultaneous equation results are more or less consistent with single equation studies.

¹⁵ The ordinary least squares and two-stage least squares estimation techniques are discussed in Chapter 6.

An example is a study by Greer (1971), with advertising intensity, concentration and growth as endogenous variables. Advertising intensity is determined by concentration and growth. Growth is determined by advertising intensity and other exogenous variables. Concentration is determined by advertising intensity, growth and some exogenous variables. The simultaneous equation approach supports the strong quadratic relationship between the concentration and advertising intensity, like the single equation approach.

Strickland and Weiss (1976) consider the advertising-sales ratio, concentration, and price-cost margins as the endogenous variables. The advertising-sales ratio is determined by concentration, margin and exogenous factors. Concentration is determined by the advertising-sales ratio and exogenous factors. Price-cost margin is determined by concentration, advertising-sales ratio and exogenous factors. Their study suggests that the 2SLS results are consistent with those obtained from the OLS technique.

In a model using a simultaneous equation approach, Chou (1986) relates the economic development of Taiwan to its industrial organisation. For a 'dichotomous market structure' he considers price-cost margin, concentration, export, and import intensity as the endogenous variables. Concentration is determined by export intensity, import intensity and other exogenous factors. Price-cost margin is determined by concentration, export, import intensity and other exogenous factors, while export and import intensity are determined by concentration, price-cost margin and other exogenous factors. Most of the findings are similar for the two estimation techniques.

2.3.3.2 Mis-specification in the Studies Based on Prior Beliefs

In empirical analyses, most studies try to relate concentration and other explanatory variables with some measures of profitability (an indicator of performance). The variables and equations are chosen mostly on the basis of prior literature. In all empirical investigations, uncertainty remains about the inclusion or exclusion of variables. Specification uncertainty to a certain extent, leads to the incorrect approximation of the estimated parameters of primary interest. Sawyer (1982) has made a number of criticisms of the specification of the structure-

performance relationships based on prior beliefs. The credibility of the studies of market structure and performance can be enhanced if these studies are based on firm economic theory rather than on prior beliefs.

2.3.3.3. Mis-specification due to Improper Functional Form

In most cross-sectional studies, a positive linear relationship has been established between concentration and profitability. In some cases, imposition of linearity may be a poor representation of data. This has been emphasised by Geroski (1982). With U.K. minimum list heading industry data, he establishes a non-linear relationship between these two variables. The model should be based on firm economic theory and statistical criteria. He starts with a profit equation with concentration, advertising intensity, growth, a diversification index, import intensity and export intensity as the explanatory variables. Geroski investigates the minimal size of the model explaining the causal relations among the variables. Advertising-sales ratio, import and export intensity are treated as exogenous. He concludes,

"... a non-linear profits equation plus two further simultaneous equations involving import and export intensity is the minimum-size model necessary to generate consistent unbiased estimators. " (1982, p 156)

Sawyer (1982) also emphasises that the 'coherent approach' of structure-performance analysis based on profit maximisation (rather than what he termed as 'literature search approach') leads to non-linear relations among structure-performance variables. Sawyer's view is that too often alternative and conflicting theories are appealed to in specifying equations.

In summary, there are many conceptual and measurement problems in structure-conduct-performance studies which should be remembered in interpreting the findings from these studies.

2.4 Australian Studies

There have been relatively few Australian studies of structure-conduct-performance relationships. This may be explained by lack of data for the relevant variables (see Round (1974)). No unambiguous profits-concentration relationship is found in the studies. The studies are summarised below.

2.4.1 Single Equation Studies

Unlike overseas studies, the direction of the profits-concentration relationship in Australian manufacturing industries is not easily and unambiguously identifiable. This is prominent in a paper by Round (1976a). He examines the strength and direction of the relationship between profitability (considering both sales-based and fund-based measures) and concentration for manufacturing industries at the ASIC three-digit level over the period 1968/9-1972/3. Results are sensitive to the profit measure. For the sales-based measures, consistently positive and significant relationships are established, while the signs are negative for the capital-based measures.

In another paper, Round (1976b) deals with multiple regression analysis to determine a relationship between price-cost margins and several explanatory variables using ASIC three-digit data. Concentration, plant-size, industry growth, the nature of the industry's product, and geographic markets served by the industry are considered as the explanatory variables. The effect of concentration on industry margins is indeterminate due to the existence of the multicollinearity. The direction of the effects of the other explanatory variables on profitability are similar to the findings from the overseas studies.

For a small economy like Australia, subject to significant import competition in many industries, the traditional oligopoly framework has to be reformulated. This is suggested in a monograph by Parry (1978). He deals with four-digit ASIC data for the manufacturing sector for the period 1972/73. Three measures of performance are considered, viz. labour productivity, price-cost margins (both gross margins on sales and return on fixed assets are

considered), and trade performance variables (based on export and import series). The profits-concentration relationship is found to be positive, but neither the concentration nor the other structural variables are found to be significant. A number of industry characteristics (e.g. labour market factors, inter-industry diversification, multi-plant operation, foreign enterprise participation) appear to be significant rather than the traditional structural variables in explaining industry performance.

In an open economy like Australia, foreign competition can be as important as the domestic structural factors in determining domestic industry profitability. Round (1978) investigates the effects of several structural variables and foreign competition on industry performance (measured by the price-cost margin) at the three-digit level. The explanatory variables considered are concentration, plant size, diversification in terms of specialisation, capital-output ratio, industry growth, imports, tariffs and foreign ownership. Both concentration and foreign ownership are positively and significantly related to the price-cost margin. A high proportion of the variation in margins is explained by the foreign competition variables.

Phillips (1978), in his doctoral thesis deals with a screened sample of 99 manufacturing industries at the ASIC four-digit level for 1968/9. He considers both sales and capital-based measures of profitability as the dependent variables. Besides concentration, a range of structural explanatory variables, viz number of firms in industry, absolute size of the firm, proxies for barriers to entry, growth and buyers' concentration are introduced sequentially into the profit equation. To capture the openness of the Australian economy, some international variables, viz. measures for import intensity, effective tariff, export intensity and direct foreign investment are added.

A significant positive relationship is established for the sales-based measure, while the profit rate on funds employed shows an inverse relationship with concentration (and for the adjusted concentration ratio as well). The findings in respect of the other variables are generally consistent with the overseas results.

In another paper, Round (1980a) considers both three-digit and four-digit data to find the effect of domestic market structure and foreign competition (in terms of tariffs) on profits

for the manufacturing sector. In both cases, the concentration-profitability relationship is found to be positive, but dis-aggregation at the four-digit level weakens the relationship causing it to be statistically insignificant. He concludes, concentration is not an important variable in determining the performance across industries, while the effective tariff rate is significant and negatively related with profitability. Further dividing his sample into two groups, viz. high-concentration industries and low-concentration industries, he tests the profit-concentration relationship. Even for the subgroups, a significant relationship between concentration and profitability can not be established.

Round (1983b) finds a negative relationship between average profitability and concentration at the four-digit level of 147 manufacturing industries over the period 1968/9-1976/7. For further investigation the sample is divided into three groups: high, medium and low concentration industries. For the sub sample analysis he indicates, "higher concentration is progressively, although weakly, associated with higher than average profit margins. Accordingly, our results present no clear-cut implications of public policies in Australia towards concentrated markets", Round (1983b, page 208).

Starting from a profit-maximising oligopoly model by Cowling and Waterson (1976), Dixon and Gunther (1986) examine the relationships among the margins, concentration, elasticity of demand, and 'apparent collusion' for 20 manufacturing industries. They estimate the degree of collusion for all industries. In this respect, they indicate that the Cowling-Waterson model may need to be reformulated under sub-optimal situations.

2.4.2 Simultaneous Equation Studies

In the Australian context, studies based on the simultaneous approach are extremely scarce. While suggesting the superiority of the simultaneous equation approach compared to the single equation approach, Round (1980b) considers only a limited number of endogenous variables (profitability and effective rate of protection). Capital-intensity, concentration, advertising-intensity, diversification, growth, decentralisation, and scale economies are considered as exogenous explanatory variables. Four-digit level data for the manufacturing sector are used

over the years 1968/9 and 1972/3. The major findings are: firstly, the higher tariff may cause inefficiency by increasing costs and thus reducing profits, and secondly, concentration is insignificant in determining industry profits.

A small linear model by Dixon (1987b) estimates the inter-relationship among concentration, margins, and advertising. The small sample includes twelve industries selling domestic consumer goods. The 'adjusted concentration ratio' (or weighted Herfindahl index, weight being the share of large firms in total market sales) is determined by margins, average size of large firms, cost-advantage ratio, and advertising-sales ratio. Adjusted concentration, advertising-sales ratio, and a variable with partial adjustment of margin (to allow incomplete optimisation) are the explanatory variables for profits. Advertising is determined by margins, concentration, elasticity of demand, and a variable indicating the proportion of sales to consumer demand. With the 3SLS estimation technique, results are similar to overseas studies with expected signs. However, the coefficient of the adjusted concentration ratio appears to be insignificant with a negative sign in the profit equation.

Ratnayake (1990), in his doctoral thesis, presents a simultaneous equation model with trade, structure, conduct and performance variables using four-digit data for 1984/85. With eight endogenous variables, viz. export and import intensity, intra-industry trade, rate of protection, foreign ownership, concentration, advertising intensity and profitability, he considers both single and simultaneous equation approaches. The results support the positive relationship between profits and concentration. He concludes that simultaneity bias may be a problem in single equation studies. A summary of Australian literature is given in Table 2.2.¹⁶

2.5 Concluding Remarks

The structure-conduct-performance paradigm plays a major role in industrial organisation and in guiding competitive policy in the post-war period. It has produced an impressive body of

¹⁶For Australian manufacturing, Williamson (1990), with pooled cross-section data explains the pricing policies of domestic established firms (with product differentiation) in the presence of import competition with the OLS and 2SLS estimation. The findings support the key role of differentiated product, while various dimensions of industry structure are also important in explaining pricing process. Here the focus is different, hence this is not listed in Table (2.1), for detailed discussion, see Williamson (1984 and 1990).

empirical results for different countries suggesting that market structure is systematically linked with market performance.¹⁷ In this respect, two different views are discussed in explaining structure-performance relationships. A number of criticisms have been identified and how they may affect the anti-trust policy conclusions and recommendations that emerge from the structure-conduct-performance paradigm.

In summary, the review in this chapter will help to keep in mind the following issues in developing the model for the study:

- i) There is a need to develop a structure-conduct-performance model based on theory (if possible) not on *ad hoc* literature survey. In this respect, variables should be added logically.
- ii) Conduct aspects should be taken explicitly to fill the gap between structure and performance. Most of the studies neglect this issue.
- iii) There is a need to specify the proper functional form of the model.
- iv) Consideration needs to be given to the effect of conceptual problems (e.g. omitting relevant variables, measurement error, simultaneity bias etc.) in explaining the structure - conduct performance relationships.

Therefore, a logical next step is to develop coherent models in explaining the structure-conduct-performance relationships for the Australian manufacturing industries. Before that, an overview of the Australian manufacturing sector is presented in Chapter 3.

¹⁷ In this thesis market and industry will be used synonymously.

Table 2.2 : A Summary of Australian Studies

Author(s)	Year & Number of Industries	Focus Variables	Estimation Technique(s)	Major Conclusion(s) related to the SCP relationships
Round (1976)a	1968-69, 1972-73, 30 three-digit industries	Profit/Sales; Profit/Funds; concentration, capital output ratio	OLS	Sales-based measures of profits are positively related with concentration while fund-based measures are negatively related with profits.
Round (1976)b	1968-69, 34 three-digit industries	PCM; concentration; risk; plant size; industry growth; capital-output ratio; regional-national dummy and consumer-producers dummy.	OLS	i) The effect of concentration on profit is indeterminate. ii) The effects of other variables on profit are similar to those in overseas studies.
Phillips (1978)	1968-69, 99 four-digit industries	PCM (both sales and capital based measure); concentration; growth; number of firms; average firm size; tariff; export/import intensity; foreign ownership. Each is tested individually	OLS linear, log linear	i) Concentration-profits relationship depends on profit measures. ii) The effect of other variables on profits are more or less same as overseas studies.

Table 2.2 : A Summary of Australian Studies (Contd.)

Author(s)	Year & Number of Industries	Focus Variables	Estimation Technique(s)	Major Conclusion(s) related to the SCP relationships
Round (1978)	1968-69 1972-73, 38 three-digit industries	PCM; concentration; average plant size; specialisation ratio; multi-plant operation; capital-output ratio; industry growth; imports; tariff; foreign ownership	OLS	i) Positive and significant relationships are found between margins, concentration and entry barriers ii) Foreign ownership variable is found to be significant in explaining profits
Round (1980a)	1968-69 and 1972-73, 40 three-digit and four-digit industries	PCM; concentration; tariff; capital intensity; advertising; growth	OLS	i) Concentration is not a significant determinant for profit for dis-aggregated data. ii) Tariff protection has led inefficiency in production and lower profits.
Round (1980b)	1968-69 and 1972-73, 136 four-digit industries	Profits, concentration, tariff, advertising intensity, growth, diversification, depth of processes and scale economies	OLS, 3SLS	i) Single equation studies may yield biased results. ii) Concentration is not a significant determinant of profits. iii) Tariff levels can be explained by demand and supply factors, tariff has a negative impact on profitability

Table 2.2 : A Summary of Australian Studies (Contd.)

Author(s)	Year & Number of Industries	Focus Variables	Estimation Technique(s)	Major Conclusion(s) related to the SCP relationships
Dixon and Gunther (1986)	1968/69; 1972/73; 1977/78, 20 three-digit industries	Profit; concentration (H-index); own price elasticity; collusion	Simulation type model, no estimation technique is used	Cowling-Watson type model needs to be reformulated to allow sub-optimisation
Dixon (1987b)	1968/69; 1972/73; 1977/78, 1982-83 12 three-digit and four-digit industries	Profits, H-index, advertising-intensity, effective tariff, average plant size, lagged profits and lagged H-index, proportion of sales on consumer goods	3SLS	Concentration has negative and insignificant impact on profits
Ratnayake (1990)	1984-85, four-digit industries	PCM, concentration, export and import intensity, intra-industry trade, proxies for protection, advertising intensity, foreign ownership and some other exogenous factors	OLS, 2SLS	i) Simultaneity exists between structure and performance variables ii) High concentration leads to higher rates of profits iii) International linkages do not influence profits significantly

CHAPTER 3

AN OVERVIEW OF THE AUSTRALIAN MANUFACTURING SECTOR

3.1 Introduction

The manufacturing sector in Australia has an important role in terms of output, employment and growth of the economy. Manufacturing is an important supplier of capital equipment and other intermediate goods to other sectors. A strong and dynamic manufacturing sector is a source of generating income, employment and growth in the economy.

This chapter reviews key aspects of the Australian manufacturing sector with particular emphasis on performance since mid 1970s. In this respect, Section 3.2 discusses the major characteristics of the Australian manufacturing sector and major policies. Section 3.3 presents an overview of the importance of the manufacturing sector in the Australian economy with some figures on production, employment and trade shares.¹ Here, some recent statistics are also included. Finally, section 3.4 adds some concluding remarks.

3.2 Major Characteristics of Australian Manufacturing and Policies

In the following section, first major characteristics of manufacturing sector are described. Secondly, structural adjustments with an overview of major policies undertaken in the manufacturing sector are covered.

¹ For the history of Australian manufacturing with statistics since the beginning of this century see Year Book Australia, Australian Bureau of Statistics, 1301.0 , No 51, Chapter 4, pp 143-282.

3.2.1 Major Characteristics

The Australian manufacturing sector is characterised with high concentration. The domestic market is small and protected both naturally and artificially. Here, major characteristics are discussed in detail.

3.2.1.1 High Concentration

Due to the small size of the domestic market, the Australian manufacturing sector is characterised with a significant level of concentration.² Concentration has been historically high and continues to be amongst the highest in the world. According to Hunter (1961b), in 1949/50, most industries have three large firms to serve the entire market. With firm data, Karmel and Brunt (1962) argue that Australian manufacturing is highly concentrated, so that monopolistic and oligopolistic behaviour are much more common in Australia than in Britain, Canada or the U.S. In a later study, Sheridan (1968) finds 61 percent of industries are either monopolies or near monopolies in 1961/62. For 120 industries, Caves (1984) shows that the four-firm concentration for Australia is at least 78 percent higher than that of U.S. counterparts. In a working paper, the Bureau of Industry Economics (BIE, 1989) reports the changes in concentration with different measures between 1972/73 and 1986/87. Comparing the concentration data for some OECD countries, it concludes that the concentration in Australia is higher than most OECD countries except Canada. The data of Table 3.1 are adopted from the BIE (1989, working paper 57). For the period between 1958 and 1984, aggregate concentration has either decreased or remains steady for U.S., U.K. and Japan. While for Canada, West Germany and Australia, it has increased. This is shown in Figure 3.1.³

²Surveys of concentration in Australian industries can be found in Hunter (1961a &b, 1963), Sheridan (1968, 1974), Norman (1970) and Round (1976c).

³ Both Table 3.1 and Figure 3.1 present aggregate concentration rather than at the usual four-firm level.

Table 3.1: Share of Total Manufacturing Activity held by the 100 Largest Manufacturing Firms, Various Countries

Years	Canada(a) percent	West Germany(b) percent	Japan(c) percent	U.S.(a) percent	U.K.(d) percent	Australia(a) percent
1958		-		23.0		
1963				33.0		
1965	43.6					
1967			37.2			
1968/69						38.0
1970					39.3	
1972				33.0	41.0	
1972/73						39.0
1974	46.2					
1976			35.9			
1977					33.0	
1978		36.6	34.3		41.1	39.0(e)
1980		37.0	33.8		40.5	
1982	47.1	39.5	34.5	33.0	41.1	
1982/83						42.0
1984		39.5	33.0		38.7	

Sources: Adapted from BIE (1989), Working Paper 57, pp 35

Notes: (a) Value added

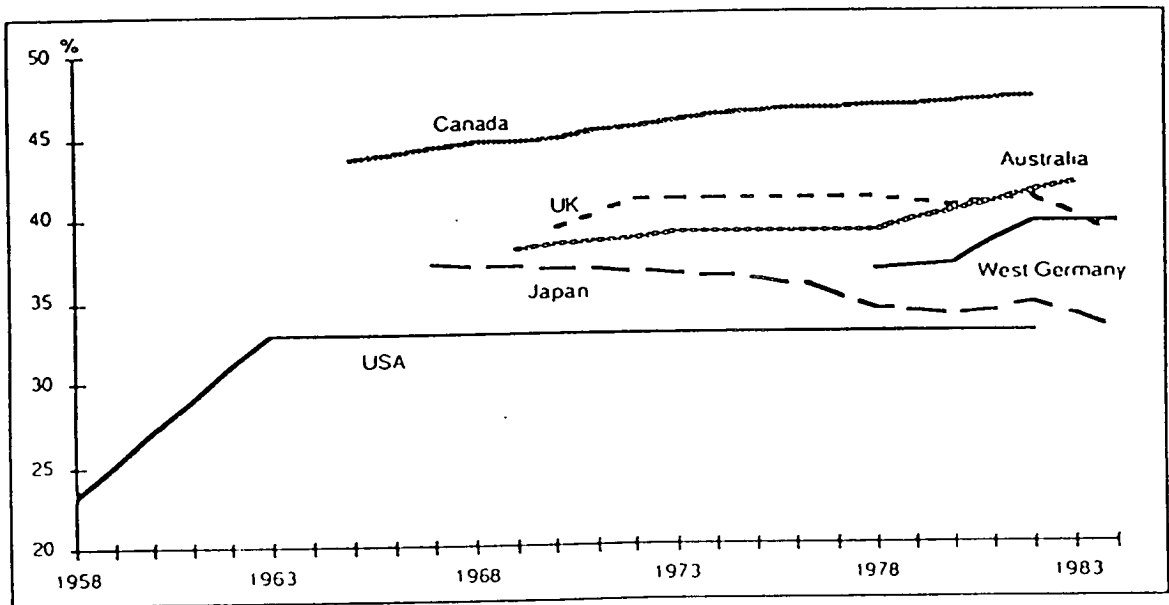
(b) Sales, including Mining, Construction, Electric Power and Gas

(c) Assets, corporations only

(d) Net Output

(e) 1977/78

Figure 3.1: Share of Total Manufacturing Activity held by the 100 Largest Manufacturing Firms, Various Countries



3.2.1.2 Evidence of Anti-Competitive Behaviour

Restrictive practices have a long history in Australia. In his pioneering articles Hunter (1961a & b, 1963) reviews many restrictive practices involving collusion between sellers in terms of price fixing agreements (both horizontal and vertical), agreements to fix market shares, trade regulation agreements, exclusive dealing agreements, level or collusive tendering. Descriptions of anti-competitive behaviour by Australian firms can be found in Karmel and Brunt (1962), Collinge (1970), Nieuwenhuysen (1970, 1976), Nieuwenhuysen and Norman (1976) and Walker (1976).

One common type of price fixing is collusive tendering. Hunter (1961b) reports,

"Collusive tendering appears to be much more common than in the United Kingdom. The volume of complaint from municipal and State government departments is consistently high...total prohibition of this particular practice." (1961b, p 178).

The level of merger activity in Australia is a major concern. The implication is that due to mergers, concentration and market power may increase and reduce competition.

3.2.1.3 Fragmented Domestic Market

The Australian domestic market is relatively small and fragmented geographically into two major areas and a number of important smaller ones. In terms of employment relative to population, manufacturing is of greatest importance in Victoria, followed by New South Wales, South Australia and Tasmania while of least significance in Queensland and Western Australia (Green Paper, Volume 1, 1975, Table 4, p 63). Industrial metals, chemical, domestic appliances and machinery are more important in New South Wales; textiles, clothing, vehicles, transport equipment, miscellaneous foods in Victoria; food and non-metallic mineral products in Queensland; non-metallic mineral products and saw milling in Western Australia; vehicles and transport equipment in South Australia; and textiles, saw milling and paper-making and industrial metals in Tasmania.

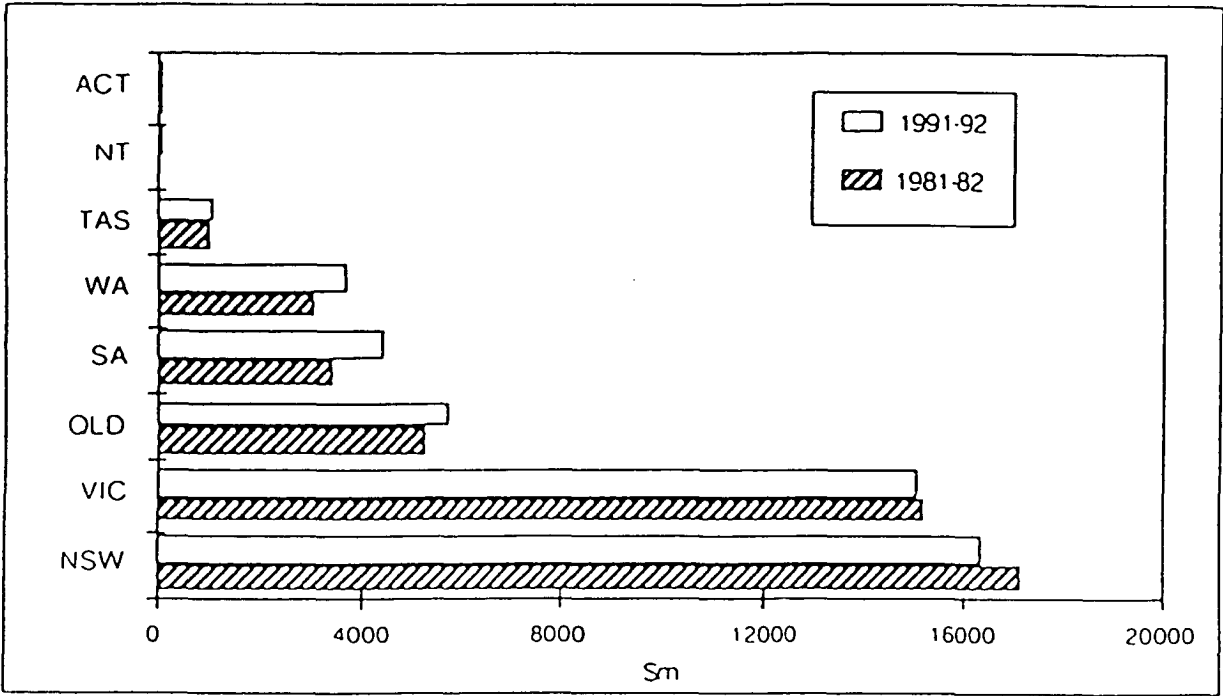
Figure 3.2 compares the manufacturing production in different states between 1981/82 and 1991/92. Manufacturing output in real term has declined in Victoria, the ACT and New South Wales over the decade to 1991/92. Over this period, real manufacturing output has increased only by 3 percent.

3.2.1.4 Highly Protected Small Open Economy

Australia is a small, relatively open economy. The domestic market is relatively small, external trade provides both challenges and opportunities for industries. Some imports are inputs and capital equipment for production, others are competing with local products. Exports provide opportunity to access wider markets, and economies of scale can be achieved in this way.

There are many forms of assistance for manufacturing industries (tariffs, sales and excise tax, subsidies and bounties). Tariffs are the most important form of assistance for protecting the import competing manufacturing industries by raising the price of imports. Tariff policies during 1950s and 1960s sheltered the local industries, particularly the export sector. A tariff review program was established by the Tariff Board and the Industries Assistance Commission. The tariff level was high, providing employment to manufacturing sector. By the end of 1980s, the average effective rate of assistance (excluding the passenger motor vehicle and textile, clothing and footwear industries) was less than half the rate of mid 1970s.

Figure 3.2 : Real Manufacturing Production, 1989 - 90 Prices



Source: ABS Cat Nos 5220, 5204

Note : Adapted from BIE, Occasional Paper 19, State Economic Performance, 1981/82 - 1991/92 (Figure 3.5, pp 16)

3.2.2 Structural Adjustments and Major Policies

The 1970s was a turbulent period for Australian manufacturing. This was due to: declining population growth rate which reduced the growth of the domestic market, increased industrialisation of the developing countries, a rapid increase in domestic wages as well as a shift in consumers' preferences towards services.

Prior to 1974, antitrust legislation was less effective. There was little competition among the domestic rival firms. In 1974, the Trade Practices Act (TPA) was introduced to restrain anti-competitive behaviour (see Conlon (1975) for the detail of the TPA). The current Trade Practices Act (TPA) 1974, amended in 1977 is designed to control the monopolies and restrictive trade practices nationwide (The TPA of 1965 established a receptive environment for the current Act). The Griffiths Committee (1988) examines the merger provisions of the TPA.

Traditionally, the manufacturing sector has focused on import replacement, protected by tariffs which have been high by world standard.⁴ By the early 1970s, development in new industrial policies emerged. The IAC Act in 1973, introduced a continuous tariff review program.

Various industrial development incentives have been introduced, e.g. export incentive, industrial research and development incentives, investment and depreciation allowance, improved funding access to small and medium sized firms. The Jackson Committee (1975) and the Crawford Committee (1979) were responsible for recommending various incentives.

Recently, 'the Committee of Inquiry into Government Competition Policy', (1993, led by Professor Hilmer) has paid attention to the performance of price fixing agreements and non-price agreements (mainly Section 45, 47 and 48 of the TPA 1977). The committee recommended some changes to those areas (e.g. removing the distinction between goods and service sectors, permitting authorisation of resale price maintenance, where it can be

⁴ In recent years, there has been emphasis to improve the international competitiveness of the manufacturing sector and to make it more export oriented.

demonstrated to offer net public benefits) where the current rules were found to be deficient in respect of a nationwide competition policy (for details, see Hilmer, 1993).

The major objective of the government (at the national, state and local tiers) by introducing a national competition policy framework is to develop an open, integrated domestic market by removing unnecessary barriers to trade and competition.⁵ It sets out a process for the review and reform of regulations and other interventions which impede competition throughout the economy. The Australian Competition and Consumer Commission (ACCC) and the National Competition Council (NCC) are responsible for providing an institutional framework for advancing competition reforms.

3.3 The Manufacturing Sector and the Australian Economy

Prior to the mid 1970s, the postwar rate of growth of demand and output had been significantly high and the role and significance of the manufacturing sector to economic and industrial development was undoubted. During the 1950s and 1960s economic and industry policies encouraged the development of a diversified manufacturing sector to cater to the domestic economy by replacing imports. However structural change in the economy has been prominent since 1970s with a high level of unemployment, inflation and lower growth. In the following years, government industrial policies encouraged structural adjustments to take place (see the White Paper on manufacturing industry (1977), the Jackson Committee Report (1975) on policies for development in manufacturing industries and the Crawford Committee Report (1979) on policies towards structural adjustments).

Between 1969/70 and 1983/84, GDP (in real terms) has increased by 2.9 percent per annum. During the same period, employment has increased by 1.1 percent per annum. By comparison manufacturing products has increased 1.3 percent in real terms. The sectors' share of GDP has declined from 22.0 percent to 16.8 percent. For the same period, share of employment in manufacturing has declined from 24.4 percent to 16.4 percent. Below some

⁵ National competition policy incorporates all major sectors in the economy including manufacturing sector.

statistics are given for output, employment and trade share for manufacturing over the period between 1970/71 and 86/87.

3.3.1 Output

In Table 3.2, GDP (at current prices in percentage term) figures for the major sectors in the economy are reported for a seventeen year period. In this period, the GDP share for both rural and manufacturing sector has declined by 2 and 8 percent, respectively. The GDP share of the mining and service sector have increased during this period. Table 3.3 compares the sectoral division of the GDP for some selected countries for 1982/84. In the service sector, the GDP share of Australia is highest. Except for Italy, the GDP share in agriculture is highest for Australia. The GDP share in manufacturing is lower in Australia than in any other country, except Canada.

3.3.2 Employment

The sectoral contribution towards employment in Australia for the period of 1970/71 and 1986/87 is reported in Table 3.4.

The service sector is the largest source of employment, followed by manufacturing for this period. Over the period, the percentage of employment by the manufacturing sector has declined by 9 percent while the percentage of employment by the service sector has increased by 12 percent. The employment for 1973 was 1,382,300 while in 1985 the figure was 1,109,400.

Table 3.2: GDP (at current prices in percentage term), 1970/71 to 1986/87

Year	Mining	Manufacturing	Services	Rural
1970/71	3	25	66	6
1971/72	3	24	67	6
1972/73	4	23	66	7
1973/74	3	22	66	8
1974/75	4	22	68	6
1975/76	4	21	69	5
1976/77	4	21	70	5
1977/78	4	20	71	5
1978/79	5	19	69	6
1979/80	6	19	68	7
1980/81	6	19	69	6
1981/82	6	19	70	5
1982/83	6	18	72	4
1983/84	6	18	71	5
1984/85	6	17	72	4
1985/86	6	17	73	4
1986/87	5	17	74	4

Source: Industries Assistance Commission (1986)

Note: Data for the last two years are from ABS (1989)

Table 3.3: The Structure of GDP of Selected Countries, 1982-84

	Agriculture	Manufacturing	Mining	Utilities and Construction	Services	Government
Australia	4.5	17.7	6.4	9.3	59.1	4.2
Belgium	2.5	23.9	0.6	9.1	51.3	14.7
Canada	3.4	16.0	5.7	8.1	38.6	16.2
France	4.0	25.3	0.7	8.3	43.3	12.8
Germany	2.0	25.3	0.7	8.3	47.3	11.7
Italy	5.7	27.4	0.0	12.6	41.0	14.0
Japan	3.3	29.3	0.4	11.1	49.2	8.5
U.K.	1.9	21.6	6.8	7.4	38.8	13.4
U.S.A.	2.3	21.0	3.9	7.0	53.9	13.0

Source: OECD (1987, pp 51)

Notes: The Australian figures are different here (from Table 3.2) due to the differences of definition by the OECD (1987) and the ASIC

Table 3.4: Employment by Sector, 1970/71 to 1986/87 (in percentage term)

Year	Mining	Manufacturing	Services	Rural
1970/71	2	24	66	8
1971/72	2	25	66	7
1972/73	1	24	67	8
1973/74	1	24	68	7
1974/75	1	23	68	7
1975/76	1	22	70	7
1976/77	1	22	70	7
1977/78	1	21	71	7
1978/79	1	20	73	6
1979/80	1	20	72	7
1980/81	1	20	72	6
1981/82	2	19	73	7
1982/83	1	19	73	6
1983/84	2	18	74	7
1984/85	1	18	75	6
1985/86	2	17	76	6
1986/87	1	15	78	6

Source: Industries Assistance Commission (1986)
Data for the last two years are from ABS (1989)

3.3.3 Trade Shares

Table 3.5 compares the trade performance (in terms of export and import intensity) between 1970 and 1983. The increase in export intensity is lowest for Australia (0.6 of a percent) and

greatest for Belgium (24.5 percent increase) over the period. Import intensity has increased by 5.6 percent, which is lower than all other countries except Canada (1.3 percent increase) and Japan (1.1 percent increase).

3.3.4 Summary Statistics from the Data Set of the Study

Here, the summary of the profit, concentration (both CR4 and H-index) and conjecture variables from the sample data set are given in next four tables (Table 3.6 to 3.9). The detailed explanations (including the statistics) of the profit, concentration and conjecture variables along with other variables used in the study are given in Chapter 6.⁶

Table 3.6 presents the number of industries in each profit class for 1977/78 and 1984/85.⁷ Among all industries, in 1977/78, around 67 percent of industries earned profits were above 18 percent. The same figure is only 7 percent for 1984/85. The percentage of industries with higher rates of return are much greater in 1977/78 compared to 1984/85. Figure 3.3 (which represents the data from Table 3.6) compares the profit shares within some size classes for 102 manufacturing industries used in the study between 1977/78 and 1984/85.

Table 3.7 presents the number of industries in each concentration (CR4) class for 1977/78 and 1984/85.⁸ Among all industries, in 1977/78, 71 percent of industries have CR4 values 40 or above. The same figure is 52 percent for 1984/85. Industries are highly concentrated in 1977/78 compared to 1984/85 for the industry sample. Figure 3.4 (which represents the data from Table 3.7) compares the concentration index (CR4) within some size classes for 102 manufacturing industries used in the study between 1977/78 and 1984/85.

⁶ The detail discussion is in Chapter 6 (section 6.2) and Appendix IA and IB.

⁷ Profit is value added less intermediate expenses less wages and salaries out of sales.

⁸ Four-firm concentration is sales accounted by the top four firms over total industry sales.

Table 3.5: Export and Import Intensity of Manufacturing Sector

	1970/72		1976/78		1981/83	
	Export Intensity	Import Intensity	Export Intensity	Import Intensity	Export Intensity	Import Intensity
Australia	16.5	21.0	18.0	25.4	17.1	26.6
Belgium	63.3	59.6	71.7	69.9	97.8	94.3
Canada	27.0	27.5	28.5	31.0	28.5	28.8
France	17.8	16.4	23.1	20.8	26.5	25.4
Germany	26.8	20.0	36.3	27.4	42.1	33.8
Italy	20.4	16.2	32.5	24.8	37.5	30.6
Japan	10.6	4.2	13.4	4.7	14.8	5.3
U.K.	18.3	16.3	25.9	24.6	23.9	25.7
U.S.A.	5.6	6.0	7.6	8.1	8.7	9.8

Source: OECD (1987)

Notes: Export Intensity is Exports as a percentage of production

Import Intensity is Imports as a percentage of apparent consumption

Table 3.6: Comparison of Profit Share (Sales) between 1977/78 and 1984/85

Share of Profits	1977/78 (Number of Industries)	1984/85 (Number of Industries)
0-0.06	1	0
0.06-0.12	2	50
0.12-0.18	31	44
0.18-0.24	57	7
0.24 and above	11	1
Total	102	102

Figure 3.3: Comparison of Profit Share (Sales) between 1977/78 and 1984/85

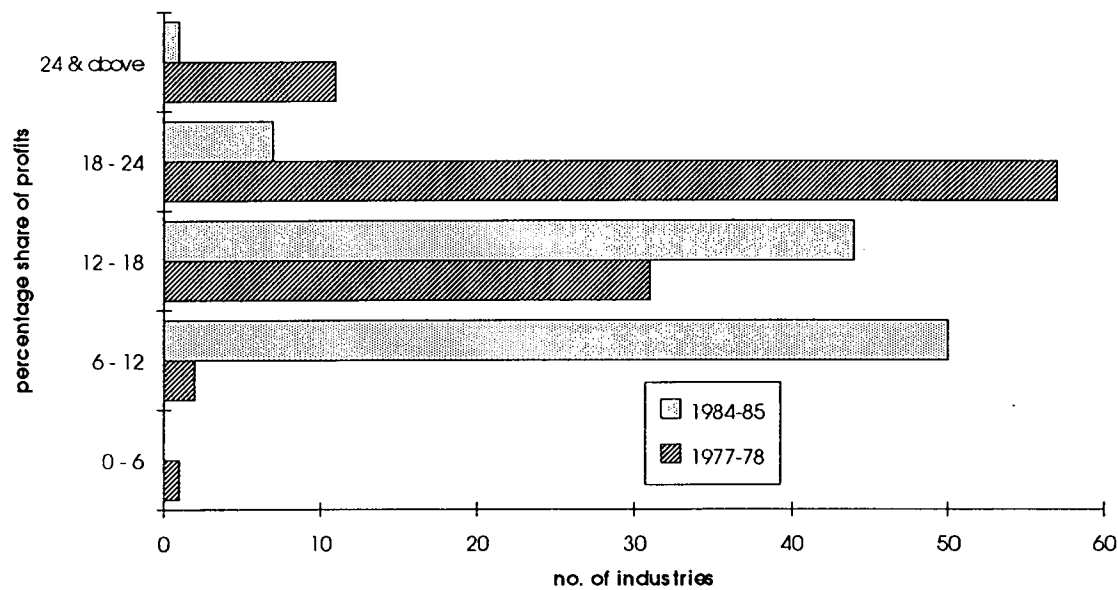


Table 3.7: Comparison of Four-Firm Concentration Ratio between 1977/78 and 1984/85

Class	1977/78 (Number of Industries)	1984/85 (Number of Industries)
0-20	5	35
20-40	25	14
40-60	22	16
60-80	33	20
80-100	17	17
Total	102	102

Figure 3.4: Comparison of Four-Firm Concentration Ratio between 1977/78 and 1984/85

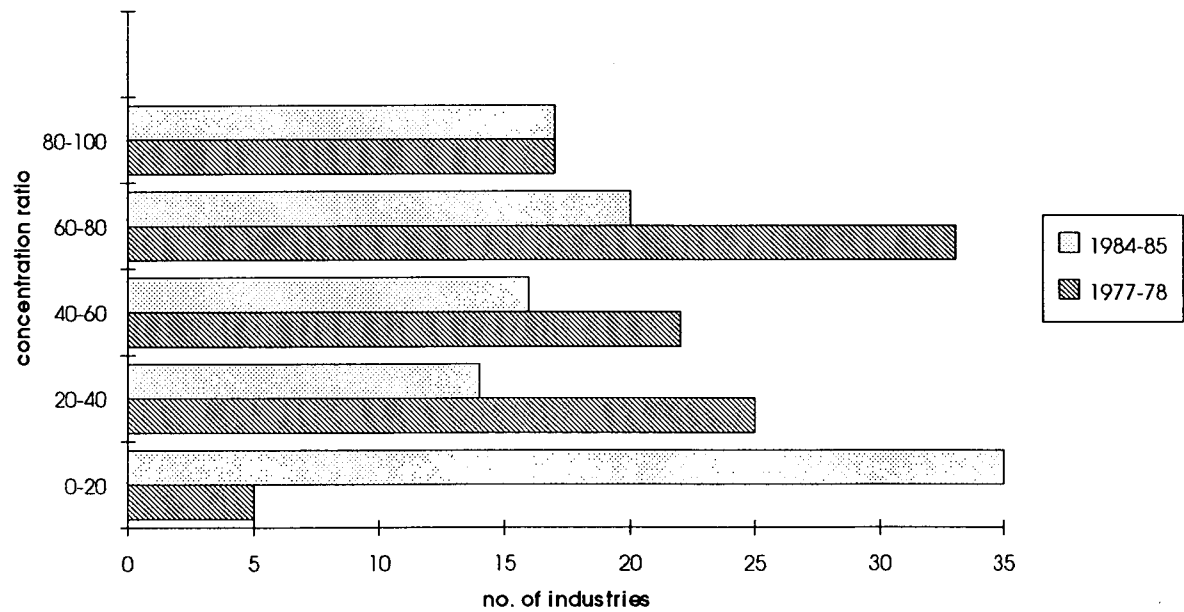


Table 3.8: Comparison of the Herfindahl-index between 1977/78 and 1984/85

Class	1977/78 (Number of Industries)	1984/85 (Number of Industries)
0-0.02	6	8
0.02-0.04	10	11
0.04-0.06	20	18
0.06-0.08	8	10
0.08-0.10	7	8
0.10 and above	51	47
Total	102	102

Figure 3.5: Comparison of the Herfindahl-index between 1977/78 and 1984/85

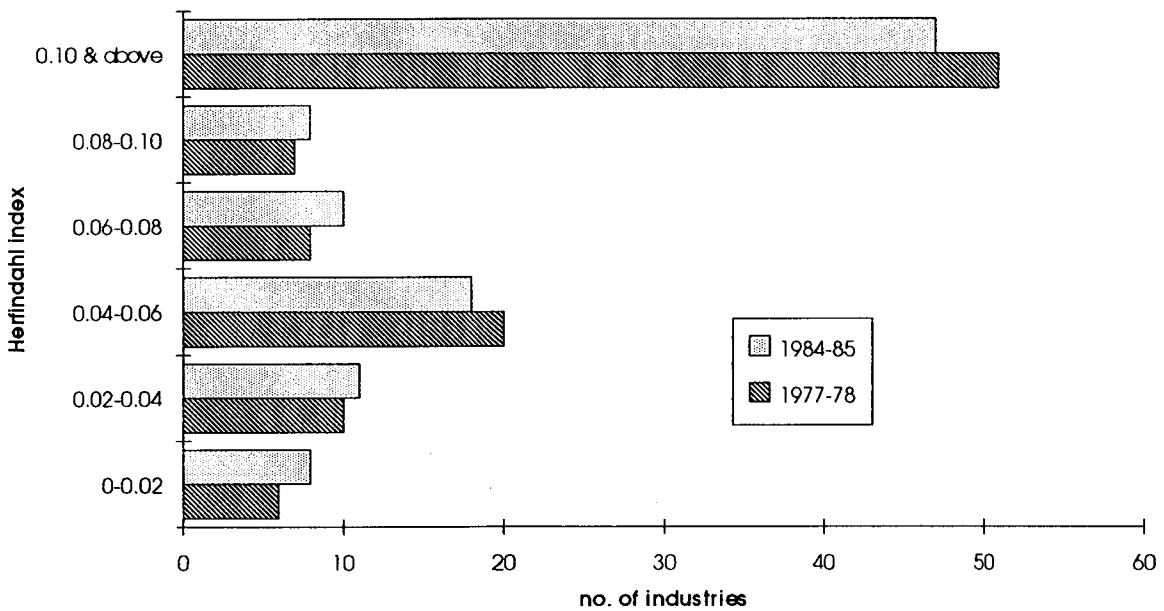


Table 3.8 presents the number of industries in each concentration (represented by H-index) class for 1977/78 and 1984/85.⁹ Among all industries, in 1977/78, 50 percent of industries have H-index values 0.10 or above. The same figure is 46.7 percent for 1984/85. Figure 3.5 (which represents the data from Table 3.8) compares the concentration index (H-

⁹ Herfindahl index is sum of squared shares of each firm, an index of market structure.

index) within some size classes for 102 manufacturing industries used in the study between 1977/78 and 1984/85.

Table 3.9 presents the number of industries with conjectures values within three classes for 1984/85.¹⁰ Among all industries, that of 65.6 percent industries have conjectures values lie between -1 and 0, for 22.5 percent of industries conjectures values are greater than 0 but less than 1 and for 11.7 percent of industries conjectures values are greater than 1.

Table 3.9: Conjectures Values, 1984/85

Class	Number of Industries	Average
$-1 \leq \text{CONJ} \leq 0$	67	-0.581
$0 \leq \text{CONJ} \leq 1$	23	0.483
$\text{CONJ} > 1$	12	4.366
Total	102	

3.3.5 Manufacturing Sector: Some Recent Figures and Expectations

Although the study includes the data from 1977/78 to 1984/85, inclusion of some current statistics might be helpful to get an overview of the present situation in manufacturing.

Table 3.10 shows the profit before income tax for the manufacturing sector over the period between 1990/91 and 1992/93. Food, beverages and tobacco is the highest profitable industry, while transport equipment faced a net operating loss in 1990/91 but a subsequent improvement occurred in 1992/93. Profit before income tax has increased by 38 percent between 1991/92 and 1992/93, following a rise of 17 percent from 1990/91 (source: Company Profits, Australia, 5651.0).

Table 3.11 presents statistics of employment for manufacturing for 1991/92. For the largest four firms, employment was highest for basic metal product, followed by non-metallic mineral product and lowest for wood, wood product and furniture and other machinery and equipment.

Recently, there have been efforts to improve international competitiveness by rationalising industries through micro economic reform (policies leading to reduce unit costs in

¹⁰ Conjectures values is derived from firm profit and share data, the detail is in chapter 6.

major sectors of the economy), including reductions in the tariff rates. As discussed in section 3.2.2, major industrial policies are framed to improve competitiveness of the manufacturing with other sectors. Table 3.12 presents sectoral contributions to the economic activities for 1994/95. In terms of production, employment, investment and capital-stock, the service sector is still leading the economy followed by manufacturing. The manufacturing sector has the highest R & D provision (55.7 percent) compared to other sectors.

The ACCI/ Westpac survey of industrial trends provides short-term expectations for the manufacturing sector. According to a survey in March 1996, there is an increase in business confidence among manufacturers. According to the ABS Australian business medium-term expectations survey (March quarter 1997 compared with the March quarter 1996), sales, capital expenditure and profits have improved and will be higher for the above period.¹¹ A summary of expectations for March 1996 through March 1997 is given in Table 3.13.

3.4 Conclusions

This chapter presents an overview of the Australian manufacturing sector and its relation with the economy. In this respect, the performance of manufacturing from the 1970s is considered. Prior to 1973/74, growth in the manufacturing sector was generally satisfactory except for some industries, most notably textiles, clothing and footwear. Since then output and employment shares have declined for all industries, except for food, beverages and tobacco industry.

The major characteristics of the manufacturing sector are a high level of concentration, a protected and small domestic market with small scale production. The development of a more competitive manufacturing sector will increase trade (with the rest of the world), real income and the standard of living of the Australian economy. Structural characteristics are important in explaining performance of the manufacturing sector. This is done in this study with the help of oligopoly models. In Chapter 4, a theoretical discussion leading to specifying the profit model is given.

¹¹ BIE, Australian Industry Trends, May 1996.

Table 3.10: Manufacturing Sector: Profit before Income Tax by Industry (\$ million)

Industry Division	1990/91	1991/92	1992/93
Food, beverages and tobacco	1,543	1,706	2,159
Textiles, Clothing and footwear	176	268	259
Paper, paper products, printing and publishing	263	756	1,026
Chemical, petroleum and coal products	711	686	1,011
Basic metal products	705	140	513
Transport equipment	-209	58	541
Fabricated metal products and other machinery and equipment	603	1,016	1,024
Other manufacturing ^(a)	1,164	1,157	1,437
Total manufacturing	4,956	5,788	7,970

Note: (a) Includes Wood, wood products and furniture; Non-metallic mineral products; and Miscellaneous manufacturing
Adapted from Yearbook Australia, vol. 77, 1995, table 18.16

Table 3.11 Employment by Industries, 1991/92

<i>Enterprise groups ranked by turnover</i>										
	Largest 4		5-8		9 - 12		13 - 16		Remainder	
Industry Subdivision	'000	Ratio	'000	Ratio	'000	Ratio	'000	Ratio	'000	Ratio
Food, beverages and tobacco	19.4	0.12	16.9	0.10	10.8	0.07	10.3	0.06	108.6	0.65
Textiles	3.9	0.15	1.8	0.07	1.9	0.07	1.4	0.06	17.2	0.66
Clothing and footwear	8.1	0.16	1.7	0.03	2.6	0.05	0.8	0.02	36.6	0.73
Wood, wood products and furniture	6.6	0.09	2.2	0.03	2.1	0.03	1.2	0.02	59.5	0.83
Paper, paper products, printing and publishing	22.7	0.23	6.9	0.07	4.9	0.05	3.7	0.04	62.0	0.62
Chemical, petroleum and coal products	7.7	0.15	2.9	0.06	3.4	0.07	3.5	0.07	33.0	0.65
Non-metallic mineral products	15.2	0.41	4.7	0.12	1.6	0.04	1.8	0.05	14.2	0.38
Basic metal products	28.2	0.45	8.6	0.14	5.9	0.10	2.7	0.04	16.7	0.27
Fabricated metal products	6.4	0.07	6.1	0.07	3.0	0.03	2.3	0.03	71.0	0.80
Transport equipment	20.4	0.25	11.4	0.14	6.9	0.08	5.5	0.07	37.3	0.46
Other machinery and equipment	9.8	0.09	8.5	0.07	4.0	0.03	3.2	0.03	88.8	0.78
Miscellaneous manufacturing	8.1	0.14	4.6	0.08	1.4	0.02	1.3	0.02	42.8	0.74
Total manufacturing	45.7	0.05	33.4	0.04	30.9	0.03	20.8	0.02	776.3	0.86

Notes : Adapted from Yearbook Australia, vol. 77, 1995, Table 18.19

Table 3.12: Sector Contributions to Australian Economic Activity: 1994/95 (percentage share in bracket)

Sector	Production ^(a) \$ million	Employment '000 persons	Investment ^(b) \$ million	Capital-stock ^(b) \$ million	R & D ^(c) \$ million
Agriculture	13 292 (3.2)	404 (5.0)	na	30 096 (7.8)	na
Mining	18 017 (4.3)	86 (1.1)	6665 (19.4)	51 473 (13.4)	309 (10.2)
Manufacturing	65 886 (15.9)	1116 (13.8)	9856 (28.7)	79151 (20.6)	1687 (55.7)
Services	280 343 (67.5)	6452 (80.1)	17 815 (51.8)	222 805 (58.1)	1032 (34.1)
Total	415 024	8058	34 366	383 525	3028

Adapted from the BIE, Australian Industry Trends, May 1996 Issue (Table 3, pp 79)

Source: ABS Catalogue Number 5206.0, 8114.0, 5625.0 and 5221.0

Notes: a) Constant 1989-90 prices b) data related to private new-capital-expenditure survey excludes agriculture. c) Agriculture due to collection difficulties, also such enterprises are believed to have low R&D activity

Table 3.13: Manufacturing expectations, expected aggregate change, March quarter 1997 compared with March quarter 1996, percent

Sub-Division	Capital Expenditure	Employment (full-time equivalent)	Sales	Profits
Food, beverages and tobacco	-5.4	0.5	3.5	11.7
Textiles, clothing, footwear and leather	0.3	-0.4	3.4	na
Wood and paper products	5.5	0.5	3.5	12.2
Printing, publishing and recorded media	na	-0.2	2.7	-1.5
Petroleum, coal, chemicals and associated products	-0.1	-0.2	2.9	8.3
Non-metallic mineral products	na	-0.8	1.7	6.1
Metal products	17.5	-0.6	2.1	-2.8
Machinery and equipment	10.5	0.6	3.7	22.3
Other Manufacturing	16.8	1.9	6.5	na
Total manufacturing	10.1	0.2	3.2	10.2

Adapted from the BIE, Australian Industry Trends, May 1996 (Table 6, pp 40).

Source: Unpublished data from ABS Catalogue No. 5250.0

Note: na denotes not available

CHAPTER 4

SPECIFICATIONS OF PROFIT MODELS

4.1 Introduction

In industrial organisation, concentration is an important element in explaining profits. In empirical studies, a positive relationship is established between concentration (an index of structure) and profitability (an index of performance). However, concentration is not the whole story of monopoly power, a refined model (based on theory rather than literature survey) including the various aspects of market structure and conduct is needed to explain profits.¹

In section 4.2, following Cowling and Waterson (1976), firstly, short-run equilibrium profit models based on oligopoly theory are specified in detail. Here, all possible versions of the profit model are developed. In section 4.3 dynamic versions of the profit model are developed, considering deviation of profits from an equilibrium level. In this respect, how profits adjust towards the short-run equilibrium level is considered assuming constant partial adjustment. Finally, some concluding remarks are added in section 4.4.

4.2 Various Versions of Short-run Profit Model

Specification of structure-conduct-performance relationships is often largely *ad hoc*. This study derives structure-performance relationships from a well known theoretical model of oligopoly. Following Cowling-Waterson (1976), a purely domestic oligopoly market is assumed with identical firms in equilibrium. Extensions of the simple model include firms of unequal sizes, heterogeneous products and international competition.

¹ There are numerous structure-conduct-performance studies for various countries, therefore providing a summary table would not be practical, a brief summary of the Australian studies is in Chapter 2, Table 2.2. For a review of overseas literature see Weiss (1974) and Scherer and Ross (1990).

4.2.1 Profit Models for the Domestic Economy

Assuming a domestic economy with no foreign competition then the following profit models can be developed.

4.2.1.1 Firms Are of Equal Size Producing Homogenous Products

There are N firms of equal size producing homogeneous goods in the industry. There is no possibility of entry and foreign competition. Input prices are given and outputs are sold to price-takers. Market price is given by the inverse demand function, $p = f(Q)$, and industry output is $Q = \sum_i q_i$, where q_i is the output of the i th firm. Cost conditions are the same for all firms and all firms make the same conjectural variations.

The profit equation of the i th firm is

$$\pi_i = p q_i - C(q_i) - F \quad (4.1)$$

where π_i is profit, p is the price, q_i is output, C is variable cost and F is fixed cost. The first-order condition for profit maximisation is

$$\frac{d\pi_i}{dq_i} = p + q_i f'(Q) \frac{dQ}{dq_i} - MC_i(q_i) = 0 \quad (4.2)$$

where $\frac{dQ}{dq_i} = \frac{dq_i}{dq_i} + \frac{dQ_r}{dq_i} = 1 + \psi_i$, with ψ_i as the i th firm's conjectural variations that

measures the change of output of remaining firms (Q_r) with respect to a change in the firm's output, and MC_i is the marginal cost. Aggregating equation (4.2) over N identical firms, after rearrangement we have

$$PCM = \frac{(p - MC)}{p} = (1 + \psi) / N\epsilon \quad (4.3)$$

where ϵ is the absolute value of the industry price elasticity of demand. Therefore, the industry price-cost margin is inversely related to the firm numbers and to the industry price elasticity of demand (ϵ), as well as directly related to the common conjectural variations term (ψ).

4.2.1.2 Firms Are of Different Size Producing Homogenous Products

Here, a purely domestic oligopoly is considered. Firms are selling homogenous products and have conjectures about the quantity responses from their rivals. Following similar steps as above from firms' profit expression, (viz. taking the weighted average of firms' margin over N firms), the average industry profit-maximising condition can be expressed as

$$PCM = \frac{(p - MC)}{p} = (1 + \bar{\psi})H/\epsilon \quad (4.4)$$

where, PCM is the industry price-cost margin (a measure of profitability), and $\bar{\psi} = \sum_{i=1}^n S_i^2 (\psi_i) / H$ is the weighted average measure of conjectural variations for the industry, S_i is the i th firm's share of industry output, and H is the Herfindahl index (a measure of concentration, equal to the sum of squared market shares over all firms in the industry).²

For equal sized firms, $H = 1/N$, with N equal to the number of firms, but generally H varies between zero and one. Taking the logarithms of both sides of equation (4.4) gives the following log-linear expression for the price-cost margin in equilibrium

$$\log(PCM) = \log(1 + \bar{\psi}) + \log(H) - \log(\epsilon) \quad (4.5)$$

² Detailed in Chapter 6, section 6.2.3.

4.2.1.3 Firms Are of Different Size Producing Heterogeneous Products

Firms who are producing differentiated products may charge different prices. Here firms can decide either their price or output or a combination of both. Now the price function of the i th firm is

$$p_i = f_i(q_1, q_2, \dots, q_n) \quad (4.6)$$

or alternatively, output is

$$q_i = g_i(p_1, p_2, \dots, p_n) \quad (4.7)$$

In the above situation, maximisation of profit with respect to output does not contain any term $dQ/dq_i = 1 + \psi_i$, as heterogeneous product can not be added to get industry output i.e., in this case $Q \neq \sum q_i$.

Cubbin (1974) develops a model of oligopoly similar to that presented above, except considering maximum profit with respect to price. Profit for the i th firm is

$$\pi_i = p_i q_i - C_i(q_i) \quad (4.8)$$

where C_i includes both variable and fixed costs. At maximum profit,

$$\frac{d\pi_i}{dp_i} = q_i + p_i \frac{dq_i}{dp_i} - MC_i \frac{dq_i}{dp_i} = 0 \quad (4.9)$$

Here

$$\frac{dq_i}{dp_i} = \frac{\partial q_i}{\partial p_i} + \sum_{j \neq i} \left(\frac{\partial q_i}{\partial p_j} \right) \left(\frac{dp_j}{dp_i} \right) \quad (4.10)$$

The term $\frac{dp_j}{dp_i} = \phi_{ij}$ is the conjectural variations term, the effect of i th firm's price change on j 's behaviour. The weighted average conjectural variations anticipated by the i th firm can be expressed as

$$\phi = \sum_{j \neq i} \phi_{ij} \frac{\partial q_i}{\partial p_j} / \left(\sum_{j \neq i} \frac{\partial q_i}{\partial p_j} \right) \quad (4.11)$$

Substituting (4.11) and (4.10) into (4.9) gives

$$q_i + (p_i - MC_i) \left(\frac{\delta q_i}{\delta p_i} + \phi \sum_{j \neq i} \frac{\delta q_i}{\delta p_j} \right) = 0 \quad (4.12)$$

The relationship between firm's demand and industry demand is complex here. From the definitional form of (4.10) Cubbin derives

$$\varepsilon_I - \varepsilon_{fi} = -(p_i/q_i) \left(\sum_{j \neq i} \frac{\delta q_i}{\delta p_j} \right) \quad (4.13)$$

where ε_I is the industry elasticity of demand when others' price change is in the same amount (i.e. $dp_j/dp_i = 1$). ε_{fi} is the firm elasticity, which measures the response faced by firm i when others keep their price constant. Rearranging (4.12) to get the price-cost margin then substituting from (4.13), we get,

$$(p_i - MC_i)/p_i = [\phi \varepsilon_I + (1 - \phi) \varepsilon_{fi}]^{-1} \quad (4.14)$$

Here, the price-cost margin depends on elasticities and the conjectural variations term. Substituting the value of ε_{fi} from (4.13) into (4.14) gives

$$(p_i - MC_i)/p_i = [\varepsilon_I + (1 - \phi)(p_i/q_i) \left(\sum_{j \neq i} \frac{\delta q_i}{\delta p_j} \right)]^{-1} \quad (4.15)$$

Assuming $\frac{\delta q_i}{\delta p_j}$ is same for all j (ie. product i is equally affected by a change in the price of its substitutes) and in equilibrium, $p_i = p_j$, then from (4.15)

$$(p_i - MC_i)/p_i = [\epsilon_I + (1-\phi)(N-1)(p_j/q_i)(\frac{\delta q_i}{\delta p_j})]^{-1} \quad (4.16)$$

$$\text{or, } (p_i - MC_i)/p_i = [\epsilon_I + (1-\phi)(N-1)\eta_{ij}]^{-1} \quad (4.17)$$

The above relation shows that price-cost margin can be determined by industry elasticity of demand, firms' conjectures, by the number of firms in the industry and by the degree of product differentiation. In summary, both for homogeneous and differentiated products, industry structure (either number of firms or concentration index), industry elasticity of demand, firms' conjectures and the degree of product differentiation are the determinants of industry profit. A logarithmic first-order approximation of (4.17) yields the average industry profit equation as

$$\log(\text{PCM}) \approx -[\log(\epsilon) + \log(1-\phi) + \log(N-1) + \log(\eta)] \quad (4.18)$$

where, η is an approximate indicator of product differentiation for an industry³.

In summary, for a closed economy, a profit model can be developed as a function of industry structure (either N or H -index), conjectures about rivals (in terms of quantity or price) with an additional factor (a measure of product differentiation) for the heterogeneous product industries.

4.2.2 Models for an Open Economy

Several researchers consider the influence of international factors in explaining industry profit. In this respect we will heavily draw upon Lyons (1981) and Jacquemin (1980) and

³ Note, here the sign for $(1-\phi)$ is negative with profit, hence positive with ϕ (price conjecture)

consider an oligopolistic industry of N firms producing homogeneous product competing with imports of the same homogeneous good.

4.2.2.1 A Model without Collusion

In Jacquemin (1980), each firm believes that there will be no reaction from its domestic or foreign competitor for any change in the output. Maximising the profits (π_i) function and after some rearrangement we get firms' profit as:

$$(p_d - MC_i)/p_d = \frac{1}{\epsilon_d} \frac{q_{di}}{q_d} \frac{q_d}{(q_d + q_m)} \quad (4.19)$$

where p_d is domestic price

$p_d = g(q_d + q_m)$ is an inverse domestic demand function

q_d is domestic demand

q_m is total imports, $q_d = \sum_{i=1}^N q_{di}$

MC_i and F_i are marginal costs and fixed costs respectively.

ϵ_d is domestic elasticity of demand

Aggregating over N firms, industry average price-cost margin can be expressed as:

$$PCM = (H_d/\epsilon_d)(1-m) \quad (4.20)$$

where H_d is the domestic Herfindhal index

$m = q_m / (q_d + q_m)$ is the import ratio

This implies the following logarithmic relation:

$$\log(PCM) = \log(H) - \log(\epsilon_d) + \log(1-m) \quad (4.21)$$

4.2.2.2 A Profit Model with Collusion

Lyons (1981) assumes both domestic and foreign firms may react to any change in output. For simplicity, only import intensity is considered as a foreign variable here.⁴ Maximising profit, with some manipulations, the firm's price-cost margin is

$$\frac{(p - MC_i)}{p} = (q_{di}/\epsilon_{qd})(q_d / (q_d + q_m) (1 + \tau_{di} + \tau_{mi}) \quad (4.22)$$

where $\tau_{di} = \delta(\sum_{j \neq i} q_{dj})/\delta q_{di}$, the i th firm's conjectures about its domestic rivals when it changes output and $\tau_{mi} = \delta q_m/\delta q_{di}$ the i th firm's conjectures about its foreign rivals. Aggregating over N firms, the average industry price-cost margin can be expressed as:

$$PCM = ((1-m)/\epsilon_d) H_d (1 + T_d + T_m) \quad (4.23)$$

where $T_d = \sum (q_{di})^2 \tau_{di} / \sum (q_{di})^2$, is the weighted average of firms' conjectures due to responses from domestic rivals and $T_m = \sum (q_{di})^2 \tau_{mi} / \sum (q_{di})^2$, is the weighted average of firms' conjectures due to responses from foreign rivals. Assuming firms' conjectures about its domestic and foreign rivals are equal, i.e. $T_d = T_m = T$ (an index of conjectures) yields

$$\log(PCM) = \log(H) - \log(\epsilon_d) + \log(1-m) + \log(1+T) \quad (4.24)$$

4.2.3 An Integrated Model for Empirical Analysis

Summarising the above models, a final version of the profit equation for empirical analysis can be written as:

⁴ The export ratio is generally very low for the data sample.

$$\log(\text{PCM}) = \beta_0 + \beta_1 \log(H) + \beta_2 \log(\text{ELAS}_{\text{own}}) + \beta_3 \log(\text{CONJ}) + \beta_4 \text{CPD} + \beta_5 \log(\text{IMP1}) \quad (4.25)$$

where CONJ is a measure of conjectures among firms, CPD is a consumer-producers dummy (a proxy for product differentiation). ELAS_{own} is the estimate of the industry price elasticity of demand ε and IMP1 is a measure of import share (m). The signs of coefficients are mostly derived from theory. The estimated coefficients β_1, β_3 are expected to be positive, while β_2, β_4 and β_5 are expected to be negative.⁵ No prediction for the sign of β_0 is generated by the theory.

In addition, the PCM is not directly observable, assuming marginal cost is equal to average variable cost, this can be expressed as the gross profit margin on sales (GPMTO). GPMTO is used as the dependent variable for empirical purposes. In this connection, the capital-to-sales ratio (INVS, a proxy variable for capital-intensity) is introduced into the estimating equation to account for the degree to which the gross profit margin misstates the price-cost margin.^{6,7} The final version of the profit model for empirical analysis can be stated as⁸

$$\log(\text{GPMTO}) = \beta_0 + \beta_1 \log(H) + \beta_2 \log(\text{ELAS}_{\text{own}}) + \beta_3 \log(\text{CONJ}) + \beta_4 \text{CPD} + \beta_5 \log(\text{IMP1}) + \beta_6 \log(\text{INVS}) + u \quad (4.26)$$

where β_6 is positive and u is disturbance term.

Also for empirical purposes, the above equation will be used with a linear functional form:

⁵ Industry elasticity of demand (ELAS_{own}) is measured here in absolute term, β_2 is expected to be negative. In equation number (4.21) and (4.24) import variable is expressed as $(1-m)$ and a positive sign is expected. For empirical purposes, only import share (m) is used, hence β_5 is expected to be negative.

⁶ INVS is investment to sales ratio, INVS is change in capital stock over a period. It is quite common to use this variable instead of capital.

⁷ To incorporate the inter-industry differences in profitability due to differences in capital intensity a control variable is added (INVS), c.g. Comanor and Wilson (1974). Since highly capital intensive industries are expected to earn a higher rate of profits. A related derivation is given in Chapter 6, section 6.2.5.

⁸ Definitions and measures of all variables are in Chapter 6.

$$\text{GPMTO} = \beta_0 + \beta_1 H + \beta_2 \text{ELAS}_{\text{own}} + \beta_3 \text{CONJ} + \beta_4 \text{CPD} + \beta_5 \text{IMP1} + \beta_6 \text{INVS} + u' \quad (4.26')$$

The signs of the coefficients are expected to be the same as with equation (4.26).

Equation (4.26) provides the final version of the short-run equilibrium model of profits and is estimated with all intermediate versions in Chapter 7 using data from 102 Australian manufacturing industries.

4.3 Disequilibrium Profit Model with Different Versions

A criticism against cross-section studies of the relationship between concentration and profits is that most of them implicitly assume that the observed relationship represents complete adjustment to market conditions. These studies neglect the dynamic nature of the relationship, which may obscure the relationship between profits and concentration.

4.3.1 Overview of the Prior Studies

Brozen (1970) argues that a positive profit-concentration relationship is a disequilibrium phenomenon and that the differences between profits of high and low concentration industries vanish over time. However, Qualls (1974) finds that the profits-concentration relationship can be explained in terms of monopoly power of dominant firms with high barriers to entry even in the long run. Mueller (1977,1985) with firm level data also finds the persistence of profits above the long-run competitive level.

Using U.S. panel data for the period between 1958 to 1981, Domowitz et.al (1986) explain the inter-temporal instability of the concentration-margins relationship by considering the influence of macro economic fluctuations. Cyclical effects are found to alter the magnitude of the differences between price-cost margins of concentrated and unconcentrated industries.

Levy (1987) considers a dynamic profit model with panel data for U.S. manufacturing industries. An incomplete adjustment is considered when past profits differ

from future expected profits. The empirical results suggest that the adjustment process is relatively fast.

Odagiri and Yamawaki (1986) estimate the long-run profit rates for the Japanese companies using the same methodology as Mueller. They conclude that the profit rate is more or less persistent. Considering a partial adjustment model, they conclude the convergence towards mean profit rate has been slow.

Other studies with panel data, e.g. by Odagiri and Yamashita (1987) for Japanese, Neumann et.al (1983) for German and Prince and Thurik (1994) for Dutch manufacturing industries deal with the persistence of profits and reach varying conclusions. A summary of the studies is given here in Table 4.1.⁹

4.3.2 Disequilibrium Profit Model with Different Specifications

A standard partial adjustment model is adopted here. The direction of the change in profits is a function of actual profits relative to the short run equilibrium level ($GPMTO^*$, equation number (4.26) or (4.26')). Unlike standard models, the equilibrium profits ($GPMTO^*$) is a function of the determinants explained in equation (4.26) or (4.26'). Any deviation of the actual level of profits from its equilibrium level results in an adjustment process that leads to changes in profits. An incomplete adjustment is allowed in each model. For empirical purposes, to compare with equilibrium results, we consider $GPMTO_t$ as the dependent variable, instead of $\Delta GPMTO_t$, i.e. changes between two periods.

Both linear and logarithmic functional forms, with a fixed rate of adjustment of profit is considered here.

⁹ There is difference between these studies and ours. Most of these studies consider persistence of profit over a period based on long-run models. The following disequilibrium versions are based on short-run.

Table 4.1: Summary of the Existing Literature

Researcher(s)	Country	Type of Study	Period(s)	Major Conclusions
Brozen (1970)	U.S.	Industry level data	1936-40, 1953-57	Profits-concentration relationship is a disequilibrium phenomena.
Qualls (1974)	U.S.	Both industry and firm level	1950-65 for industries and 1951-1968 for firms	Supports persistence of profits for high concentrated industries with barriers to entry.
Neumann, Bobel and Haid (1983)	Germany	Company level data	1965-77	Profit margins increase during upswings and decrease during recessions for highly concentrated industries.
Mueller (1977, 1983 and 1985)	U.S.	Panel data for firms	24 years	Even in the long run, profit does not approach the competitive level.
Connolly and Schwartz (1985)	U.S.	Panel data for firms	1963-82	Profit adjustment remains incomplete even after two decades.
Odagiri and Yamawaki (1986)	Japan	Time series data for corporations	1964-80	The normalised profit rate is persistent for the companies, as the convergence towards mean profits rate is weaker and volatile.
Levy (1987)	U.S.	Four-digit panel data for industries	1963, 1967 and 1972	Adjustments to abnormal profits are relatively fast.
Prince and Thurik (1994)	Netherlands	3-digit panel data for industries	1975-1986	Price-cost margins are less pro-cyclical in concentrated than in less concentrated industries.

Note: Only Odagiri and Yamawaki (1986) and Levy (1987) consider the dynamic model of partial adjustment of profits.

4.3.2.1 Disequilibrium Profit Model with Linear Functional Form

In this version, following the partial adjustment model, all variables are in linear functional form, with

$$\Delta \text{GPMTO}_t = \text{GPMTO}_t - \text{GPMTO}_{t-1} = \mu' (\text{GPMTO}_t^* - \text{GPMTO}_{t-1})$$

or,

$$\text{GPMTO}_t = \mu' \text{GPMTO}_t^* - (1-\mu') \text{GPMTO}_{t-1} \quad (4.27')$$

where ΔGPMTO_t is the change in profits (in absolute terms) between two periods. μ' is the rate of adjustment and remains *constant*. μ' is between zero and one. GPMTO_t^* is equilibrium profit as represented by equation (4.26'). In estimation, GPMTO_t is used as the dependent variable, so $(1-\mu')$, the coefficient of GPMTO_{t-1} , represents adjustment of profits for the full period and is expected to be positive.

An alternative version used in the literature is considered below where change in profit is in relative terms.

4.3.2.2 Disequilibrium Profit Model with Logarithmic Functional Form

Relative change in GPMTO is considered between two periods as

$$\Delta \text{GPMTO}_t = \text{GPMTO}_t / \text{GPMTO}_{t-1} - 1 = (\text{GPMTO}_t^* / \text{GPMTO}_{t-1})^\mu - 1 \quad (4.27)$$

where ΔGPMTO_t is the change in profits (in relative term) between two periods. μ is the rate of adjustment and remains *constant*. μ is between zero and one. GPMTO_t^* is equilibrium profit as represented by equation (4.26). In estimation, GPMTO_t is used as the dependent variable. Therefore $(1-\mu)$, the coefficient of GPMTO_{t-1} , represents adjustment of profits for the full period and is expected to be positive.

Taking logarithm of both sides yields,¹⁰

$$\log(\text{GPMTO}_t) - \log(\text{GPMTO}_{t-1}) = \mu[\log(\text{GPMTO}_t^*) - \log(\text{GPMTO}_{t-1})]$$

or,

$$\log(\text{GPMTO}_t) = \mu \log(\text{GPMTO}_t^*) - (1-\mu) \log(\text{GPMTO}_{t-1}) \quad (4.27.1)$$

4.4 Conclusions

In this chapter different versions of the equilibrium and disequilibrium profit models are specified. In this respect, firstly, an oligopoly framework is taken into account to derive the short-run equilibrium profit models. Secondly, disequilibrium versions of the profit models are presented. In Chapter 7, the findings from these models are presented. Two other core variables in the profit model are concentration and firms' conjectures. The next task is to specify a model of concentration and a model with firms' conjectures separately to explain the relationships among the structure, conduct and performance variables. This is done in the following chapter.

¹⁰ This version is considered as the logarithmic functional form. It performs better in terms of signs and significance in estimating the short-run equilibrium profit model and is also derived theoretically from oligopolistic equilibrium.

CHAPTER 5

SPECIFICATIONS OF CONCENTRATION AND CONJECTURES MODEL

5.1 Introduction

The analysis of the determinants of market structure is central to the study of market performance. Industry concentration is the most widely empirically studied among various elements of market structure. It is often viewed as the basic determinant of market power and, hence, the conduct and performance of firms. In this chapter, a short-run equilibrium concentration model (with different versions) is specified following the oligopoly theory.

In the previous chapter, it is noted that the determination of price-cost margin (and hence price and output) in an oligopoly market structure depends on concentration, demand elasticity and a firm's conjectures about its rivals with other control variables. Along with concentration, firms' conjectures are explained separately with structural determinants.

The chapter is organised as follows. Firstly, the concentration models are taken into account. Section 5.2 presents a literature survey of the determinants of levels and changes in concentration. Section 5.3 develops a short-run equilibrium concentration model (with different versions) following oligopoly theory, while section 5.4 contains the disequilibrium profit model (with different versions).

Secondly, studies of firms' conjectures and related literature is discussed. Section 5.5 contains a brief overview of traditional non-cooperative oligopoly models and recent game theory approaches (as an alternative approach to explain conjectures) to oligopoly. In this connection, major criticisms of the traditional approach are mentioned. A summary of empirical studies in the literature with an outline of the game theory is presented here. Section 5.6 develops a model explaining the industry conjectural variations with some

determinants used in the study. A summary with concluding remarks for both concentration and conjectures model is included in section 5.7.

5.2 Determinants of Concentration: An Overview of the Literature

Industry concentration refers to the number and size distribution of firms within an industry. Concentration influences market power and therefore expresses the oligopolistic nature of a market. Most studies in industrial organisation (IO) consider concentration (an index of market structure) as given and examine the effects of concentration on profitability (an index of market performance). An alternative argument is that concentration can not be treated as an exogenous variable, and can be explained with some variables. These determinants of concentration are used to explain inter-industry variation in concentration.

5.2.1 Literature Survey on Determinants of the Level of Concentration

A large number of cross-section studies in U.S., U.K. and Canada explain concentration with measures of entry barriers, innovation, merger and presence of unions. Detail of the literature can be found in Curry and George (1983).

Ornstein, Weston and Intriligator (1973) explain concentration in U.S. manufacturing by the number of firms, relative industry size, advertising intensity, capital intensity, growth of value added and government expenditure to total output. Gupta (1983) explains concentration with single and simultaneous equation models for Canadian manufacturing industries. Economies of scale relative to industry size, absolute capital requirement entry barrier, advertising intensity, research and development intensity, effective rate of tariff protection, foreign ownership, multi-plant operations are considered as explanatory variables. Most of the above variables are found to be significant in his OLS results, while the results for his simultaneous model are different for a few variables. Other researchers using simultaneous equation systems explain concentration with other variables for various countries (see, Martin (1979), Jacquemin et.al. (1980), and Chou (1986)).

Ratnayake (1990) develops a concentration model for the Australian manufacturing industries. He considers economies of scale, capital intensity, advertising intensity, industry size, foreign ownership, export and import intensity and trade protection variables. His findings support the importance of trade variables (rather than the structural variables) in explaining the inter-industry differences in concentration.

5.2.2 An Overview of the Literature of the Determinants of the Changes in Concentration

Mueller and Hamm (1974), examine changes in the four-firm concentration ratio in U.S. manufacturing between 1947 and 1970. Besides initial concentration, industry growth rate, industry size, net firm entry and product differentiation are used as explanatory variables for concentration change. Their partial adjustment coefficient is 0.12 for a twelve-year period (considering a larger sample model for 1958 to 1970). They conclude that concentration increased significantly in consumer goods industries with a high degree of advertising outlay.

Wright (1978) estimates a lagged concentration coefficient of 0.13 in U.S. manufacturing over the period 1947 to 1963. His dependent variable is the change in the concentration ratio, constructed by considering that the initial concentration ratio will vary between zero and unity. A product differentiation dummy, industry size, growth rate of sales and the initial concentration are used as explanatory variables.

Jenny and Weber (1978) report a model identifying the factors behind concentration trends in the French manufacturing sector over the period 1961/69. As explanatory variables they consider initial concentration, various proxies for barriers (e.g. economies of scale, absolute capital cost requirements and product differentiation), industry growth rate and net firm entry. The estimated coefficient on the lagged concentration ratio is 0.02 (for their full sample model). Economies of scale and absolute capital requirements are identified as particularly important in explaining concentration change. Also, their analysis suggests that the deconcentration effect is significant for the industries with low barriers to entry and for those that initially have moderate concentration.

In a model similar to Mueller and Hamm (1974), Mueller and Rogers (1980) emphasise the effect of advertising in explaining the causes for changes in concentration over the period 1947/72 for the U.S. manufacturing. Their estimated adjustment coefficient is 0.08 for 1947/58 and 0.15 for 1958/72.

Caves and Porter (1980) use U.S. manufacturing data over the period 1954/72 and suggest a model where changes in concentration are explained by lagged (or partially lagged) changes in variables, viz proxies for economies of plant size, cost disadvantages of small plants, net entry of establishments and diversification. They do not consider the adjustment effect directly in their model. They report the values of partial adjustments for the simple regressions of current concentration on a constant and lagged concentration for five-year intervals for the above periods. These are 0.029, 0.046, 0.054 and 0.067. For the full period it is 0.177.

Hart and Clarke (1980) consider a model for the proportionate change in the five-firm concentration (in terms of employment instead of sales) for the U.K. manufacturing industries over the period 1958 to 1968. Logarithmic changes in the measures of plant size, industry size, the logarithm of the initial concentration, the ratio of plants to enterprises, mergers and advertising intensity are used in explaining changes in the logarithm of the concentration ratio (in terms of employment). The estimated coefficient of lagged concentration is 0.24.

Levy (1985) considers changes in concentration for the U.S. manufacturing sector over the period 1962 to 1973. The change in the four-firm concentration ratio is used as the dependent variable. Explanatory variables include advertising intensity, minimum efficient scale, the lagged concentration ratio and the growth rate of sales for the industries. The estimated coefficient of lagged concentration ratio is between 0.30 and 0.43.

In Australia, Dixon (1987b) develops a model with four-digit level data for the manufacturing industries over the period 1968/69 to 1982/83. The estimated coefficient of lagged concentration (four-firm) is 0.12. Initial concentration, advertising-sales ratio, growth rate and growth rate of value added are used as independent variables to explain changes in

the concentration ratio. A summary of studies with their estimated adjustment coefficients is given in Table 5.1.

Table 5.1: Estimated Adjustment Coefficient for Different Countries

Researcher(s)	Country	Period	No of Years	Estimated Annual Adjustment Rate
Mueller and Hamm (1974)	U.S.	1958-70	12	0.010
Wright (1978)	U.S.	1947-63	16	0.008
Jenny and Weber (1978)	France	1961-69	8	0.002
Mueller and Rogers (1980)	U.S.	1958-72	14	0.011
Hart and Clarke (1980)	U.K.	1958-68	10	0.027
Caves and Porter (1980)	U.S.	1954-72	16	0.011
Levy (1985)	U.S.	1962-73	11	0.031
Geroski and Masson (1987)	U.S.	1963-67	4	0.031
Dixon (1987b)	Australia	1968-82	14	0.009

Note: Last column is calculated from the information given in the studies mentioned here, using the formula in Appendix 7.1 with concentration instead of profit.

5.3 A Theoretical Framework for the Short-run Equilibrium Model of Concentration

Starting from Cowling and Waterson (1976) model, Clarke and Davies (1982) develop a model of concentration, where concentration is determined by the industry elasticity of demand, a measure of variability in marginal costs between firms, conjectures between firms and the number of firms in the industry. Also, they emphasise both concentration and profits are determined simultaneously by demand and cost conditions (and the behaviour of market participants).

5.3.1 Equilibrium Models of Concentration

Here three versions are developed, the first version directly follows from the Cowling-Watson model. The second version has a flavour of the Clarke-Davies model but with variable conjectures, which are endogenous in the model. For the third version, we add a product-differentiation variable to incorporate the heterogeneity of products.

5.3.1.1 Cowling-Watson Version with Cournot Behaviour

This model allows for cost differences across firms producing homogeneous product and assumes no collusion among firms. These are the assumptions for an asymmetric Cournot model. In this situation, the profit maximising condition can be expressed as

$$p(1-\varepsilon^{-1}(q_i/Q)) = MC_i \quad (5.1)$$

Rearranging equation (5.1), we get,

$$q_i/Q = \varepsilon (1-MC_i/p) \quad (5.2)$$

Summing over N firms yields

$$1 = N\varepsilon - \varepsilon \sum MC_i/p \quad (5.3)$$

or, an expression for industry price (p) is

$$p = \varepsilon(N\varepsilon-1)^{-1} \sum MC_i \quad (5.4)$$

Squaring equation (5.2) and taking the sum over N firms yields

$$\Sigma q_i^2/Q^2 = \epsilon^2 \Sigma (1-MC_i/p)^2 = \epsilon^2 (N-2\Sigma MC_i/p + \Sigma MC_i^2/p^2) \quad (5.5)$$

Substituting the value of p from equation (5.4) gives

$$H = \Sigma q_i^2/Q^2 = -N\epsilon^2 + 2\epsilon + [1-N\epsilon]^2 \Sigma MC_i^2 / (\Sigma MC_i)^2 \quad (5.6)$$

$\Sigma MC_i^2 / (\Sigma MC_i)^2$ can be called the Herfindahl index of costs and may be expressed as $(1+v_c^2)/N$, v_c is the coefficient of variation of marginal costs. Substituting this into equation (5.6) gives

$$H = 1/N + (1-\epsilon N)^2 v_c^2 / N \quad (5.7)$$

Taking logarithms of both sides

$$\log H = \log (1 + (1-\epsilon N)^2 v_c^2) - \log N \quad (5.8)$$

A first-order approximation to the above relation is given by

$$\log H = \theta_{01} + \theta_{11} \log N + \theta_{21} \log \epsilon + \theta_{31} \log v_c \quad (5.9)$$

where θ_{11} , θ_{21} are negative, θ_{31} is positive. Therefore, according to this model, the number of firms, elasticity of industry demand and variability in marginal costs between firms determine the level of concentration.

5.3.1.2 **Clake and Davies Version with Different Conjectures among Firms**

This model considers industries with cost differences across firms producing homogeneous products, allowing also for different conjectures among firms. In this case assuming that firms have different conjectural variations, and ψ_i is defined as

$$dq_j/q_j = \psi_i dq_i/q_i \text{ for all } i \neq j \quad (5.10)$$

Here, ψ_i denotes the conjectural variations parameter and are not restricted to any particular oligopoly behaviour.¹ A lower value of ψ_i implies rivals will not react proportionately. ψ_i equal to -1, implies competitive behaviour, ψ_i equal to 0 gives the Cournot case and at the other extreme, i.e. in perfect collusion, ψ_i equal to $(1-1/H)$. Depending on the value of ψ_i , we may have an outcome ranging from competitive to monopoly solution for the industry. Varying ψ_i , implicitly we assume conjectures are endogenous in the model.

Aggregating over all firms we get the measure for an industry $\bar{\psi}$ as follows:²

$$\bar{\psi} = \sum_{i=1}^n S_i^2(\psi_i) / H \quad (5.11)$$

Adding this conjectural variations term to the log-linear approximation above, equilibrium concentration equation can be expressed as³

$$\log H = \theta_{02} + \theta_{12} \log N + \theta_{22} \log \epsilon + \theta_{32} \log v_c + \theta_{42} \log (1 + \bar{\psi}) \quad (5.12)$$

In this model concentration is also determined by the number of firms (N), elasticity (ϵ), differences of costs between firms (v_c) and the conjectures variable for the industry is $(1 + \bar{\psi})$.⁴ The signs for the variables are as in the Clarke and Davies (1982) study, viz. θ_{12} is indeterminate, θ_{22} is negative and θ_{32} , θ_{42} are positive.⁵ For empirical application, ϵ is

¹ The difference between this model and Clarke and Davies (1982) model is that different conjectures among firms are assumed, Clarke and Davies assume the same conjectures for all firms within an industry.

² Derivation is in Chapter 6.

³ As with the profit model, this expression is not strictly derived from Clarke-Davies model, however, here there is a closer comparison.

⁴ $(1 + \bar{\psi})$ is used as a measure of conjecture, instead of $\bar{\psi}$ in all models. When $\bar{\psi}$ is negative, the logarithmic form of $\bar{\psi}$ can not be considered.

⁵ Estimates of elasticity are in absolute term, hence a negative relationship is expected.

$ELAS_{own}$; reciprocal of v_c i.e., cost disadvantage ratio and CONJ is used for $(1+\bar{\psi})$ for both (5.9) and (5.12).

5.3.1.3 Considering Heterogeneous Product the Final Version for Empirical Purposes

Following the theoretical discussion on equilibrium models, an equilibrium concentration model can be stated as in equation (5.12). In terms of the estimates for empirical purposes, the number of firms (N) is called as NOF and the elasticity of demand (ϵ) is $ELAS_{own}$. Instead of the coefficient of variation of cost (v_c), the cost-disadvantage ratio of smaller firms (CDR) is used.⁶ Industry conjecture(s) is $(1+\bar{\psi})$ and is denoted as CONJ. Equation (5.12) provides the basic relationship for estimating the determinants of equilibrium concentration. To incorporate heterogeneity of products, a consumer-producer dummy (CPD) is included into the final version. A positive relationship is expected. Therefore, the final expression (for estimation purpose) of the equilibrium concentration model is

$$\log H = \theta_{03} + \theta_{13} \log N + \theta_{23} \log ELAS_{own} + \theta_{33} \log CDR + \theta_{43} \log CONJ + \theta_{53} CPD \quad (5.13)$$

As with the profit models, for empirical purposes, in Chapter 8, equations (5.9), (5.12) and (5.13) are estimated with the logarithmic functional form. Corresponding versions with a linear functional form are (5.9'), (5.12') and (5.13') as below

$$\log H = \theta'_{01} + \theta'_{11} \log N + \theta'_{21} \log ELAS_{own} + \theta'_{31} \log CDR \quad (5.9')$$

$$\log H = \theta'_{02} + \theta'_{12} \log N + \theta'_{22} \log ELAS_{own} + \theta'_{32} \log CDR + \theta'_{42} \log (1+\bar{\psi}) \quad (5.12')$$

⁶ Clarke and Davies consider cost advantages of large firms to measure the differences in costs among firms. We use reciprocal of this variable, viz. cost-disadvantage ratio (CDR) of small firms, hence a negative relationship is expected with concentration.

$$\log H = \theta'_{03} + \theta'_{13} \log N + \theta'_{23} \log ELAS_{own} + \theta'_{33} \log CDR + \theta'_{43} \log CONJ + \theta'_{53} \log CPD \quad (5.13')$$

5.4 Disequilibrium Versions of Concentration Model

Disequilibrium versions of the concentration models are developed following similar argument to that used in the profit models in the previous chapter. The direction of the change in concentration is a function of actual concentration relative to the equilibrium level. Any deviation of the actual level of concentration from its equilibrium level results in an adjustment process that leads to changes in concentration. Like the profit model, to compare the findings of disequilibrium version with equilibrium model, the current concentration (H_t) is used as the dependent variable, instead of ($H_t - H_{t-1}$).

5.4.1 Disequilibrium Concentration Model with a Linear Functional Form

A linear specification of the adjustment process as has been used in many previous studies is given by

$$\Delta H_t = H_t - H_{t-1} = \lambda' (H_t^* - H_{t-1}) \quad (5.14')$$

where ΔH_t is the change in concentration (in absolute terms) between two periods. λ' is the rate of adjustment and remains *constant over industries*. λ' is between zero and one. H^* is the equilibrium level of concentration and is represented by (5.9'), (5.12') or (5.13'). In estimation, H_t is used as the dependent variable, so $(1-\lambda')$, the coefficient of H_{t-1} , represents adjustment of concentration for the full period and is expected to be positive.⁷

⁷ The difference between the assumption of previous studies and this study is important to note. Here a *short run equilibrium model* is considered with a partial adjustment of concentration towards equilibrium level. But other studies start from the *long run equilibrium model* and consider a partial adjustment of concentration towards long run equilibrium level.

Also as in the previous chapter, an alternative specification is considered.

5.4.2 Disequilibrium Concentration Model with Logarithmic Functional Form

Partial adjustment in a short-run equilibrium model with a logarithmic functional form can be expressed as,

$$H_t/H_{t-1} = (H_t^*/H_{t-1})^\lambda \quad (5.14)$$

Taking the logarithm of both sides,

$$\Delta \log (H_t) = \log (H_t) - \log (H_{t-1}) = \lambda[(\log H_t^*) - \log (H_{t-1})] \quad (5.14.1)$$

where $\Delta \log (H_t)$ is the change in concentration (in relative terms) between two periods. λ is the rate of adjustment and remains *constant over industries*. λ varies between zero and one. H^* is the equilibrium level of concentration and is represented by equation (5.9), (5.12) or (5.13). In estimation, $\log (H_t)$ is used as the dependent variable, so $(1-\lambda)$, the coefficient of $\log (H_{t-1})$, represents the adjustment of concentration for the full period and is expected to be positive.

In summary, both the equilibrium and disequilibrium concentration models are specified above. The empirical findings from these models are discussed in Chapter 8. In the following sections a model of conjectures is specified after some literature review.

5.5 Oligopolistic Interdependence

Despite considerable research, no theory has provided reliable predictions of price or output under oligopoly market structure. Each firm's action depends on the unknown reactions of the rivals and the complex interdependencies cause a problem in explaining rational

behaviour. Depending on the firm's conjectures about their rivals' action, industry price can lie anywhere between the competitive and the monopoly level.

Bowley (1924), in his seminal work first introduces the concept of conjectural variations. The expected reaction of its rivals due to a change in the quantity (price) of firm i , as subjectively perceived by firm i , is called conjectural variations. In our model, we consider the conjectural variations either as an indicator of the firm's strategy, or as an indicator of degree of collusion. In the following section mainly non-cooperative models of oligopoly are discussed.

5.5.1 Non-cooperative Oligopoly Models and Conjectural Variations

Oligopoly can produce any intermediate output between the competitive level and monopoly level depending on conjectural variations. Industry output will be lower with high profit if: i) rivals are expected to be more responsive to each firm's action or ii) the firms' beliefs about the others' responsiveness are similar.

The first, and still widely used, model of non-cooperative oligopoly behaviour is developed by Cournot (1838). The Cournot model assumes conjectural variations as zero. Each firm assumes away the response from its rivals in setting its own output. In a single-period model, a firm assumes rivals' outputs are predetermined and maximises profit.

The Bertrand (1883) model considers price (instead of quantity as per Cournot) as the decision variable in his non-cooperative model. Each firm assumes that rivals will not respond to its price changes. In the Stackelberg (1934) model, the leader firm maximises profit assuming Cournot behaviour from its followers.

In the dominant firm or price leadership model, a single firm or a group of firms (the leader) choose their price and other firms (the followers) consider price as given and act as competitive firms. The dominant firm (or group) takes into account its impact on both market price and the quantity of output supplied by the fringe firms in choosing its output level. This model assumes that all fringe firms are price-takers. This implies all fringe firms act as if they have conjectural variations for output changes equal to -1.

For a single firm, all three models yield the monopoly solution and for an indefinitely large number of firms Cournot and Stackelberg equilibrium approach a competitive solution. Also, the Bertrand equilibrium with homogenous product always provides a competitive solution (as long as there are at least two firms with unlimited capacity). With heterogeneous product, it differs from competitive equilibrium and the number of firms in the industry affects prices.

Friedman (1983) criticising static or 'one-shot' conjectural variations models, reports that the firms maximise one-period profits rather than discounted stream of profits over a given planning horizon. Conjectural variations can at best be described as a static approximation to the real-time action and reaction that arises in a dynamic framework.

Conjectural variations are generally *ad hoc* and inconsistent with rational behaviour of firms when they are out of equilibrium. Some researchers consider consistent (or rational) conjectural variations, i.e. the actual responses from rivals in the event of a change in quantity (price) decision by firm i (see Bresnahan (1981), Kamien and Schwartz (1983), Boyer and Moreaux (1983)).

An association of firms that explicitly agree to coordinate its activities is called a cartel. If the cartel includes all firms in the industry, firms enjoy monopoly profits. The theory of cartels is based on **cooperative oligopoly** (see Stigler (1964) for detail).

5.5.2 Game Theory

The exposition of game theory (a rigorous tool) to explain the oligopolistic interactions has occurred in the last few decades. Game theory deals with players with linked pay-offs and their choices are conditional on rivals' choices.

5.5.2.1 Static Games and Empirical Studies

Here players are firms, each firm tries to maximise their single-period profits (payoff). Most of the studies in this area deal with a specific industry rather than cross-sections. This is more

appropriate for a homogeneous products, where prices are observable and can be compared directly. A brief discussion of the studies is presented here.

Iwata (1974) derives and estimates the cost and demand functions for three firms (Asahi, Nippon and Central) of the Japanese flat-glass industry.⁸ He estimates conjectural variations for the window glass and polished plate glass industry separately. For window glass, the first two firms' conjectural variations lies between Cournot and perfectly collusive model, while for the polished plate glass a different pattern is found.⁹ The conjectures, demand, and cost function parameters are used to measure the monopoly power of the industry.

Gollop and Roberts (1979) test for equality of conjectural variations for firms' various size classes within the U.S. coffee-roasting industry with 160 firms. Their model is based on the necessary conditions for producer equilibrium, which includes the firms' conjectural variations as unknown parameters. Within such simultaneous systems, the estimated conjectural variations are interpreted as the conjectures the firm must have held, in order for its observed input and output choice to have been the result of a profit-maximisation decision. The production model is based on the trans-log production function and marginal productivity conditions, with the market demand elasticity as an exogenous estimate.

Using the same data as the Gollop and Roberts study, Roberts (1984) first uses the shadow-profit function to develop his model. This is based on the variable profit function and related output supply and factor demand equations to analyse short-run pricing behaviour of firms in an oligopoly market. Parametric tests are applied for: i) Cournot behaviour, ii) dominant firm behaviour, and iii) price-taking behaviour. The hypothesis of Cournot and dominant firm behaviour are rejected, while the hypothesis of price-taking behaviour can not be rejected except for two firms.

Appelbaum (1982) first introduces the use of dual cost function approach to model non-competitive markets. Employing a simultaneous equation system to measure the

⁸ Two popular specifications in empirics of static models are first-order approach (based on first order maximisation condition and demand functions) and dual approach (based on shadow-profit functions, input and output-demand equations and output supplies). For further discussion see Slade (1992).

⁹ Iwata (1974) argues that this is due to higher international competition for the polished plate glass. The greater competition reduces conjectural variations towards competitive level.

intensity of competition in industries she considers input demand, supply and market demand equations. The empirical results are based on aggregate data of an industry. This requires the assumption of constant and equal marginal costs for all firms. Table 5.2 provides an overview of some studies in this area indicating the industry studied, whether products are homogeneous or differentiated and whether firms make quantity or price as choice variable.

Table 5.2: Empirical Studies Based on Static Games and Focus Variable

Researcher(s), Year	Industry	Type of Product	Choice Variable
Iwata (1974)	Flat glass	Homogenous	Quantity
Gollop and Roberts (1979)	Coffee roasting	Homogenous	Quantity
Appelbaum (1982)	Several	Homogenous	Quantity
Roberts (1984)	Coffee roasting	Homogenous	Quantity
Slade (1986)	Retail gasoline	Differentiated	Price
Bresnahan (1987)	Automobiles	Differentiated	Price
Gasmi, Laffont and Vuong (1992)	Soft drinks	Differentiated	Price

5.5.2.2 Dynamic Games and Empirical Studies

Static models can be described as useful summary statistics of the outcomes of oligopolistic interdependencies. The complex strategic behaviours are captured in the dynamic models.

Most dynamic models are based on repeated or state-space analysis.¹⁰ Kalai and Stanford (1983) reconcile the conjectural variations and repeated game theory showing that various conjectures are "credible" in the equilibrium. Dockner (1992) relates dynamic

¹⁰ Dynamic games has little relation with this work. The discussion on literature is given here in brief.

oligopolistic competition with static conjectural variations equilibrium. Using a differential game model with infinite horizon and adjustment costs, he concludes that the static conjectural variations models approximate long-run dynamic interactions.¹¹

5.6 Determinants of Conjectures Considered for the Model

Unlike profit and concentration models, we are unable to specify a model of conjectures with determinants which are derived theoretically from oligopoly models.¹² In the following paragraphs some structural determinants are specified which can explain conjectures.

The major hypothesis in oligopoly models is that high concentration induces collusion.¹³ If a few large firms dominate the industry and if they coordinate their activities, they can change price (or output) neglecting the actions of others. This is supported by Stigler (1964), where a positive relationship is established between Herfindahl index and collusion among firms in terms of a formal or informal cartel. Therefore, a positive relationship is expected between H and CONJ.

According to Shepherd (1990), stable industry conditions help tacit collusion to be more effective. Stability and certainty in the market help the firms to anticipate rivals' conduct more accurately. A positive relationship can be expected between STABLE and CONJ.¹⁴

In a boom period, with strong demand growth in sales, firms can easily cheat without fear of detection, hence collusion is less likely to be effective. On the other hand, with weak growth, firms will avoid cheating due to the possibility of loss in sales, which enhances the possibility of collusive outcome. A negative relationship is expected between GROW and CONJ.

¹¹ For more discussion on dynamic oligopoly theory see Shubik (1982), Driskill and McCafferty (1989), Maskin and Tirole (1987) and following references.

¹² To my knowledge, there is no study that develops such a model.

¹³ High values of conjectures implies collusion. These two terms are used in the study synonymously.

¹⁴ Here, one important point to note, the STABLE variable measures the stability of concentration between two periods. Also in disequilibrium versions of concentration, the change in concentration between two periods is considered. In some sense, this is bit overlapping.

For homogeneous products, prices are same for all firms. It is hard to cheat for firms with single price. Therefore collusion is more stable. On the other hand, firms with heterogeneous product have more difficulty agreeing on collusive behaviour. Hence a negative association is expected between CPD and CONJ.

Collusion and imports are related in opposite direction assuming both domestic and foreign firms have constant marginal cost of production and foreign firms are price takers. Also it is assumed that the import price (including transportation costs and tariff) lies in between non-collusion and the joint-profit maximisation prices (both may occur without trade). This implies that the payoffs from collusion among the domestic firms are reduced compared to a situation without a competitive pressure from abroad. A negative relationship is expected between IMP1 and CONJ.¹⁵

In summary, the model of conjectures can be expressed as follows:

$$\log (\text{CONJ}) = \kappa_0 + \kappa_1 \log (H) + \kappa_2 \text{ STABLE} + \kappa_3 \text{ GROW} + \kappa_4 \text{CPD} + \kappa_5 \log (\text{IMP1}) \quad (5.15)$$

where κ_0 can take any value; κ_1, κ_2 are positive; and $\kappa_3, \kappa_4, \kappa_5$ are negative. For empirical purposes, as with profit and concentration models, a linear functional form is considered below for empirical purpose in Chapter 8.

$$\text{CONJ} = \kappa'_0 + \kappa'_1 H + \kappa'_2 \text{ STABLE} + \kappa'_3 \text{ GROW} + \kappa'_4 \text{CPD} + \kappa'_5 \text{IMP1} \quad (5.15')$$

Signs of coefficients are same as (5.15).

¹⁵ This argument is taken from Stalhammar (1991).

5.7 Concluding Remarks

In this chapter, firstly, short-run equilibrium concentration models (based on oligopoly theory) are specified. In this respect, the whole range of variables used in previous studies are not considered.¹⁶ Secondly, allowing partial adjustment of concentration towards equilibrium, disequilibrium versions of concentration models are developed.¹⁷

Next to develop a model of conjectures, traditional oligopoly models are reviewed briefly and an outline of game theory models (as an alternative approach to explain conjectural variations) is presented with some empirical studies. A conjectures model is specified in terms of some structural determinants.¹⁸

This is only a first step to the Australian literature to explain conjectures with some industry structural variables. It is noted early that conjectural models have defects, e.g. these are static models and can not be used for multi-period. In this respect, a dynamic game model with more relevant variables could be more appropriate to explain conjectures. However, a conjectures model is developed here, which is consistent (in terms of variables and theory) and can fit in with the rest of the analysis (i.e. within profit and concentration model).

¹⁶ In the equilibrium model, N is treated as exogenous, but in most studies in this area N is treated as endogenous and determined with concentration.

¹⁷ A deviation from short-run equilibrium is considered here. In other studies, deviation from long-run (steady state) equilibrium is considered instead of short-run.

¹⁸ Important point to note here, is that this model can not be derived mathematically. To my knowledge, there is no study in this respect. A study by Rosenbaum and Manns (1994) develops a similar model following Cowling-Watson study. Similar type of arguments are followed here.

CHAPTER 6

VARIABLES WITH MEASURES, DATA BASE AND ESTIMATION TECHNIQUES

6.1 Introduction

This chapter begins with a discussion of variables and their measurement. Section 6.2 provides the measures of variables, while the description of data base is given in section 6.3. A detailed description of data sources with measures in Appendix I. In section 6.4, the econometric procedures used in estimation and the diagnostic tests applied are explained in detail. Finally, some conclusions are added in section 6.5.

6.2 Measures of Variables

In this section, the variables are defined with measures. For some variables, alternative measures contained in the literature will also be covered.

6.2.1 The Profitability Measures

The alternative measures of profitability commonly used in the empirical literature are: the accounting rate of return on capital (in terms of assets or equity) and the rate of return on sales (the gross profit margin).

The first measure of profitability is the accounting rate of return on capital (in terms of assets and equity). There is no consensus among the writers who suggest a capital based measure of profitability. Hall and Weiss (1967) prefer the return on equity arguing that:

Capital structure is an element of input mix. Either profit maximisation or sales maximisation would require some optimal rate of borrowing, which differs from industry to industry depending on such things as stability and growth prospects. As a result, rates of return on assets should differ between industries even in perfectly competitive long-run equilibrium, but rates of return on equity should tend toward equality between industries (1967, p 321).

Other researchers favour rates of return on assets rather than equity. Stigler suggests,

The main limitation [of the equity approach]... is that it leaves the characteristics of the capital lenders unexplained.... We argue that the essential symmetry in the theory of inter-industry allocation of loan funds and equity funds supports the view that they should be combined in calculating the rate of return (1963, p 123).

Apart from the lack of consensus among researchers, the accounting rate of return as a measure of performance has some limitations. Firstly, depreciation methods are different among firms and industries, affecting the calculated rate of return. Secondly, Fisher and McGowan (1983) have pointed out accounting procedures include certain activities, such as research and development expenditures and advertising, as current expenses rather than capital expenditures. They suggest the internal rate of return as a valid measure of economic profit, as it is equalised by the competitive process over time. Benston (1987) also argues that economists lack 'idiosyncratic knowledge' necessary to interpret accounting data. Also researchers (mostly for U.K. studies) have used gross profit margin as a measure of the price-cost margin. In practice, marginal cost is often difficult to obtain, and is estimated from average variable costs. With this restrictive assumption, empirical studies use $PCM = (P - AVC_1)/P$ as a measure of performance

The data to find an accounting rate of return are not available at the four-digit industry level. Also, the Cowling-Watson type model suggests PCM as a measure of profits on sales rather than profits on capital. Therefore profits on sales is considered as a measure of performance. Alternative measures of PCM that will be considered here are i) the percentage gross returns on sales (GPMTO) for the industry and ii) the percentage gross returns on value added (GPMVA).

Gross profit is equal to turnover plus changes in stock minus purchases and selected expenses, rent and leasing expenses and wages and salaries. Information regarding each of these components is available at the ASIC four-digit level from the ABS (catalogue no 8113.0).

6.2.2 Popular Concentration Measures

Here popular concentration measures used in literature, viz. the seller concentration ratio, the Herfindahl index, the Hannah and Kay index and the entropy index are discussed.

6.2.2.1 The Seller Concentration Ratio

The numerical index used most widely by industrial organisation and antitrust specialists is the *d*-firm concentration ratio, defined as the combined market share of the largest *d* firms in the industry. Market share can be measured in terms of any economic variable such as employment, total assets or value added. Sales or turnover is the most popular choice in empirical studies to date. The *d*-firm concentration ratio is calculated as

$$CR_d = s_1 + s_2 + \dots + s_d \quad (6.1)$$

where *s* is the share of each firm (in terms of turnover, employment etc). The choice of *d* is arbitrary, mostly determined by the government agency responsible for collecting data. For equal-sized firms, the *d*-firm concentration ratio is *d*/*n*. The minimum value is equal to zero and maximum value is equal to one. One major limitation of this index is that it represents a single point on the cumulative concentration curve, therefore neglecting information outside the largest *d* firms. This violates 'the principle of transfer' suggested by Hannah and Kay (1977).

6.2.2.2 The Herfindahl Index (1950)

An alternative summary measure of industry structure is the Herfindahl (H-index) defined as the sum of squared values of shares of all firms (n)

$$H\text{-index} = \sum s_i^2 \quad (6.2)$$

For equal sized firms $H=1/n$, the lower limit is zero and upper limit is one. The squaring of shares implies more weight to the shares of large firms. It satisfies all properties suggested by Hannah and Kay (1977). It has a continuous distribution and combines aspects of both number and size distribution of firms. Our theoretical oligopoly model suggests the H-index as a measure of concentration rather than any other index.

6.2.2.3 The Hannah and Kay Index

Hannah and Kay (1977) suggest a one-parameter class of numbers equivalent indices

$$HK = \left(\sum_{i=1}^n s_i^\theta \right)^{\frac{1}{1-\theta}} \quad (6.3)$$

where $\theta > 0, \theta \neq 1$

In the case, where $\theta = 2$, HK represents the Herfindahl numbers equivalent. This index is referred to as the 'numbers equivalent' index. High values of θ imply greater weights to the largest firms in the distribution and lower values emphasise the presence of smaller firms. Thus, when $\theta = 0$, $HK=N$, so that only numbers matter, while as $\theta \rightarrow \infty$, HK tends to the reciprocal of the largest firm's share. In summary, for a given value of θ , HK indicates the number of

firms with equal sizes which would record the same level of concentration. Therefore, HK is an inverse measure of concentration.

6.2.2.4 The Entropy Index

Entropy (E), is a term in physics and used as a measure of the unavailable energy in a closed thermodynamic system. In market share terms, it uses the same information as the H-index but in a complicated form. The most simple first-order entropy is defined as

$$\log (E) = - \sum_{i=1}^n s_i \log(1 / s_i) \quad (6.4)$$

With equal sized firms, $s_i=1/N$ for all i and $E=-N(1/N)\log(1/N)=\log N$, if firms are very unequal in size, E will tend to zero. Therefore, E is related to both dimensions of concentration. Low values of E represent high concentration. An advantage of this measure is that for the analysis of concentration with distinct sub-groups of firms, it can be decomposed into components for within and between sub-groups.

6.2.2.5 Comparing Concentration Indices

Some economists argue that although measures of concentration differ widely, most of the more respectable indices, e.g. concentration-ratio, H and E , provide similar results in empirical studies. These concentration indices are highly correlated and they yield similar ranking of industries. However, some authors reject this argument, showing different concentration measures yield different results. Various criteria have been suggested in literature on which to base the choice of concentration measure. Davies (1979) suggests that different concentration indices can be compared by investigating the shape of 'iso-concentration curves'. Hannah and Kay (1977) present a list of axioms that a concentration measure should satisfy. Sometimes researchers have to rely on the availability of data. The Herfindahl index is considered in the main part of analysis as it is theoretically derived from our models. For comparison, the four-firm concentration ratio is also used in some of the empirical testings.

The H-index from the grouped data is found with the following steps. The mean share per firm in each group is calculated before squaring this figure and multiplying by the number of firms (usually four) in each group. Summing these values over all groups in an industry gives the industry Herfindahl index, H. This tends to give a smaller value of the H index than is found by taking separate shares for each firm.

The four-firm concentration ratio (CR4) = turnover of top four firms/total turnover

6.2.3 Conjectural Variations Term or Conjectures (CONJ)

In oligopoly theory, conjectures are an important element in a firm's decision process. There is no unique theory or formula in this respect. Studies the focus on some particular markets (eg, banking sector, airlines) attempt to infer conjectures by leaving a free parameter which can be interpreted as conjectures. In this study we follow a simple approach. Here an indirect estimate of conjectures variable is derived from the Cowling and Waterson (1976) model, by manipulating the profit maximising condition. This is described below.

Manipulation of profit-maximisation condition in equation (4.2) yields

$$(P - MC_i)/P = -\frac{q_i}{P} \frac{dP}{dQ} \frac{dQ}{dq_i} = -\left(\frac{Q}{P} \frac{dP}{dQ}\right) \left(\frac{dQ}{dq_i} \frac{q_i}{Q}\right) = -s_i (1 + \psi_i)/\epsilon \quad (6.5)$$

where ψ_i is the conjectural variations variable and measures the expected change of output of remaining firms with respect to a change in the i th firm's output, and s_i is the share of the i th firm in industry output. This implies that

$$\psi_i = - (PCM_i \epsilon / s_i) - 1 \quad (6.6)$$

Elasticity of demand (ϵ) is measured in absolute value, therefore $\psi_i = (PCM_i \epsilon / s_i) - 1$.

The data are in terms of four-enterprise groups, so an implicit assumption in finding industry conjectures here is that all firms within a given four-enterprise-group have the same share and conjectures. Aggregating (6.6) over all firms in an industry, an average conjectures measure for each industry can be expressed as follows:

$$\bar{\psi} = \sum_{i=1}^n s_i^2 (\psi_i) / H = \sum s_i^2 [(PCM_i \epsilon / s_i) - 1] / H \quad (6.7)$$

The difference between this measure of conjectures and that of other studies is that here an industry instead of a firm, is considered as a unit. For this cross-industry study, an industry measure is more appropriate than using a firm measure.

The estimates of conjectures are not restricted for this study to any specific type, which implies they correspond to any behavioural mode with values of $\bar{\psi}$ varying between -1 and ∞ . $\bar{\psi}$ is -1 when firms assume their output has no effect on market output as with perfect competition, it is zero for the case of Cournot oligopoly and is $(1/H - 1)$ for the case of implicit collusion. For our analysis we use $(1 + \bar{\psi}) = \text{CONJ}$ as the estimate of conjectures.

Some limitations of this conjectures variable are worth mentioning at this point:

Firstly, the average industry conjectures measure is derived from three factors:

- i) PCM_i (firms' price-cost margin)
- ii) ϵ (elasticity of demand)
- iii) s_i or H (firm's share or concentration)

To measure conjectures, a representative firm's profit is considered from each four-enterprise group. There could be spurious relationship between the conjectures measure and industry price-cost margin. as any error terms in these variables (viz, industry price-cost margin, concentration and conjectures) mightl be correlated by construction.

The nature of the data and applied econometric techniques used in the study should be considered in interpreting the likely impact of any spurious relationship on the findings.¹ Firstly an indirect measure of conjectures is derived here using the most disaggregated data at the four-digit ASIC class level available for four-enterprise group. This data set is rich in the sense as the enterprise (firm) size grouping is done at the level of four-enterprise group for all firms within an industry. So it is possible to incorporate the interaction among the firms (within four-enterprise group) in an industry. Calculations based on equation 6.6 may be correlated with errors in right-hand-side variables. Yet, the average value from equation 6.7 may be unrelated to errors in the average values of the right-hand-side variables.

Secondly, we conduct an indirect test for spurious relationships due to correlation of the variables. In chapter 9, a simultaneous equation technique is used to test the same models. Estimating the models with the simultaneous technique formally takes care the problem of spurious relation among variables. The simultaneous equation estimation techniques are described in detail in the later part of this chapter (section 6.4.1.4). This is related to a major criticism dealt in literature viz, examining simultaneity bias in explaining the structure-conduct-performance variables. The findings (Table 9.1, Chapter 9) in that chapter supports that there is simultaneity bias in the profit equation in explaining the structure-performance relationship, where this simultaneity bias reflects correlated errors in the variables.

6.2.4 Own Price Elasticity ($ELAS_{own}$)

The estimates of own price elasticity (ϵ) of demand are obtained from the ORANI data base. These estimates correspond to the Australian input-output table and can be more aggregated than the ASIC four digit level (which is the level for the other variables in this study).²

¹ Alternatively, considering conjectures measure for a different year (say 1977/78) in the regressions may show the differences between the regression results. We tried at some stage without much success. Here it is hard to conclude that the differences in findings are due to either removal of the spurious relationship or a weak relationship in the value of the 'true' conjecture variable over the periods.

² The elasticity estimates are taken from Blampied (1985). The ORANI data base is based on 100⁺ commodities, which correspond to the official ABS input-output tables. Estimation of household elasticities was done at the level of 15 commodities. These values are then mapped more or less mechanically to the level of 100⁺ commodities. This is reported in Tulpule and Powell (1978). Any errors in the elasticity measures due to excessive aggregation will also affect the value of the conjectural variations variable as calculated from 6.6.

6.2.5 Capital-Intensity (INVS)

The census measure of the price-cost margin (the gross profit margin, GPM) includes fixed capital costs and returns on capital, so that it may be biased toward capital-intensive industries. To include the differences in capital-intensity among industries, a measure of the capital-output ratio is added as an explanatory variable for the price-cost margins. The relationship between the gross-margin (GPM) and the capital-sales ratio (K/S) using a CES production function can be expressed using the following derivation:

The CES production function with constant returns to scale is

$$Q = [a_1 K^\rho + a_2 L^\rho]^{1/\rho}, \rho < 1 \quad (6.8)$$

where Q is output, K and L are capital and labor input respectively, a_1 and a_2 are capital and labor coefficient and ρ is the elasticity of substitution.

For minimum cost,

$$MC = \frac{w}{\partial Q / \partial L} = \frac{r}{\partial Q / \partial K} \quad (6.9)$$

Now,

$$\partial Q / \partial L = a_2 (Q/L)^{1-\rho} \quad (6.10)$$

and

$$\partial Q / \partial K = a_1 (Q/K)^{1-\rho} \quad (6.11)$$

therefore,

$$w/r = \partial Q / \partial L / \partial Q / \partial K, \quad (6.12)$$

and

$$wL/rK = a_2(Q/L)^{-\rho} / a_1(Q/K)^{-\rho} \quad (6.13)$$

and

$$rK/wL = a_1(Q/K)^{-\rho} / a_2(Q/L)^{-\rho} = a_1(Q/L)^{\rho} / a_2(K/Q)^{\rho} \quad (6.14)$$

Therefore, the relationship between marginal and average variable costs here is

$$MC = AVC(1 + a_1/a_2(K/L)^{\rho}) \quad (6.15)$$

$$GPM = \frac{P - AVC}{P} = \frac{P - MC}{P} + \frac{MC - AVC}{P} = \frac{P - MC}{P} + \frac{AVC}{P} \left[\frac{rK}{wL} \right] \quad (6.16)$$

Again,

$$AVC = wL/Q \quad (6.17)$$

Therefore,

$$GPM = \frac{P - MC}{P} + \frac{rK}{PQ} = \frac{P - MC}{P} + r\left(\frac{K}{PQ}\right) \quad (6.18)$$

In the absence of proper data, the average of investment on sales over seven year period (1977/78 to 1984/85) is considered as a proxy for capital-sales ratio.³

6.2.6 Import Intensity

In this study, the structural measures (both four-firm concentration ratio and Herfindahl index) are not adjusted for trade. Therefore, a variable for foreign competition is included explicitly to incorporate the openness of the Australian economy. The variable generally used in empirical studies to measure the degree of foreign competition is import intensity. This can be measured in two ways:

$$1) \text{ IMP1} = \frac{M}{S}, \text{ imports as a ratio of domestic sales} \quad (6.19)$$

where M (imports) = the f.o.b. value of imports for home consumption

X (exports) = the f.o.b. value of exports

S (domestic Sales) = TO (industry turnover) + M - X

$$2) \text{ IMP2} = \frac{M}{TO + M}, \text{ imports as a ratio of industry turnover (local production) plus imports} \quad (6.20)$$

³ See IAC (1995).

The first measure is preferred as in its denominator domestic sales is used to express the share of imports rather than industry turnover. For empirical analysis, we consider both measures of import competition. The empirical findings do not differ materially as between these two measures. Marginally better fits are obtained using IMP1 (which is preferred theoretically) measure, so these results will be reported.

6.2.7 Product-Differentiation (CPD)

In absence of advertising data, a consumer-producer dummy (CPD) is used as a proxy for product differentiation. If the proportion of final demand to intermediate demand is greater than unity, then the industry is classified as a consumer goods industry. Otherwise it is classified as a producer goods industry. CPD is zero for producer goods and one for consumer goods industries.

6.2.8 Stability in Concentration (STABLE)

A dummy variable is considered to measure the stability of concentration over time, viz. $STABLE = 1$ if $|H_{84} - H_{77}| \leq 0.05$, otherwise 0.⁴

6.2.9 Growth in Sales (GROW)

GROW represents the percentage change in turnover between 1977/78 and 1984/85 *i.e.*

$$GROW = (TO \text{ of } 1984/85 - TO \text{ of } 1977/78) / TO \text{ of } 1977/78 \quad (6.21)$$

⁴ We consider 0.05 as dividing value as average of $|H_{84} - H_{77}| = 0.047$

A few additional variables are considered below which are not used in the oligopoly based models but will be used in the *ad hoc* versions of profit and concentration models in Chapters 7 and 8.

6.2.10 Proxies for Entry Barriers

Economies of scale (MES), cost-disadvantage ratio (CDR) and MESCDR (considers both economies of scale and cost disadvantage of small firms) are considered as proxies for barriers in *ad hoc* versions.

6.2.10.1 Economies of Scale (MES)

Scale economy barriers will be greater, the larger is the proportion of industry output supplied by a MES firm. In the Australian manufacturing sector, most of the firms are of sub-optimal size. To avoid this problem, Phillips calculates MES as the reasonably efficient scale (RES). In the study, this measure is considered as the proxy for economies of scale.

To find RES, the mid point is determined by calculating the cumulative total of value added for the various employment size classes, and identifying the size class containing the 50th percentile of industry value added. The value added of this class is then divided by the number of enterprise groups in the class to provide an estimate of the proportion of industry output supplied by a reasonably efficient firm.

6.2.10.2 Cost Disadvantage Ratio (CDR)

Cost disadvantage barriers for potential entrants may arise due to a) the control of supply of vital raw material by established firms, b) lower prices of raw materials due to bulk buying by large established firms, c) efficient management for established large firms. d) the imposition of a risk premium by financial markets to small new firms due to the possibility of failure to repay

loans. CDR is measured as the average value added per worker in the rest of the firms over the average value added per worker in the large firms.⁵

6.2.11 Export Intensity (EXP)

Export-intensity (EXP) is used for the ad hoc version, and measured as exports over domestic sales, i.e. $EXP = X/S$, where

X (exports) = the f.o.b. value of exports

S is domestic sales

6.2.12 Effective Rate of Protection (EFFECT)

In empirical studies, alternative measures of protection have been used, viz. a) nominal rate of protection and b) effective rate of protection. Caves (1976) suggests the effective rate measure is more appropriate as it takes into account factors of production and inflation. The effective rate (EFFECT) is used rather than nominal rate as the former considers both final product and inputs, so is more pertinent to a study of structure-performance relationships (see Hitiris (1978)). Data for EFFECT are available from the Industries Assistance Commission (IAC) at the four-digit level.⁶

6.3 Data Base and Industry Sample

In Australia, the Australian Bureau of Statistics (hereafter, ABS) follows the Australian Standard Industrial Classification (ASIC).⁷ In the manufacturing sector (C-Division) in the ASIC, there are 12 two-digit subdivisions, 41 three-digit groups, and 173 four-digit classes.⁸

⁵ Dixon (1987a) uses the reciprocal of this measure as the cost advantage ratio in the concentration equation.

⁶ For an explanation of their method of calculations, see IAC, Annual Report, 1986/87

⁷ For a detailed description see *Australian Standard Industrial Classification, Volume 1*, 1983, Catalogue No 1201.0.

The database for most of the variables of the study has been supplied on magnetic tape by the Australian Bureau of Statistics for the manufacturing enterprises classified by industry at the ASIC four-digit level for the 1977/78 and 1984/85 financial years.

There are some limitations to the data set, which should be mentioned. Firstly, single establishment enterprises which employed less than four persons (including working proprietors) are excluded. It is argued that they contribute an insignificant portion for the totals for turnover, employment, wages and salaries, etc. for the manufacturing sector as a whole. However, although their contribution to totals may not be large, they represent a significant portion of the total number of firms. The truncated size distributions may in some cases give a distorted picture of industry structure. It should be remembered that the statistical analyses in this study do not consider small enterprises.

Secondly, to preserve confidentiality the ABS supplied all information in the magnetic tape not in terms of individual enterprise but for four enterprise group. For the purpose of the study, the totals for each data item have been divided by the number of enterprise (usually four) wherever it is needed.

The data items which are available from the magnetic tape (Catalogue number 8113.0) are turnover (TO), opening stocks (OS), closing stocks (OC), purchases and selected expenses (P&E), rent and leasing expenses (R&L), depreciation on land and buildings (DLB), depreciation on other assets (mainly plant and equipment (DPE)), net capital expenditure on land and building (KLB), net capital expenditure on plant and equipment (KPE), wages and salaries paid (W&S), employment of males (EM), employment of females (EF).⁹

The development of an appropriate database required use of other sources for some of the variables. Missing data and concordance problems among the different sources of data

⁸Theoretically meaningful industries implies the grouping of firms producing outputs among whom high cross elasticities of demand or supply exists. It is important to note that industry classification sometime excludes some substitutable products and includes products unrelated in demand. The effect of aggregation bias on the structure-conduct-performance relationships is considered in Chapter 7, section 7.3.4.

⁹ Here the description of the data series is given in detail because this is an unpublished series and will be used for most of the variables. For other sources see Appendix IA.

reduces the number of industries in the sample to 102. Description of industries is given in Appendix II.

Appendix IA describes the sources and measures of variables used in the study and a table with descriptive statistics of all variables is presented in Appendix IB.

6.4 Statistical Estimation Techniques and Diagnostic Tests

In the following section, the discussion on estimation techniques and diagnostic tests used in this study is covered.

6.4.1 Simultaneity

In most cases the ordinary least squares (OLS) method is used to estimate the models. However, the existence of simultaneity among structural variables is examined for the models. There are several econometric techniques in the literature to examine simultaneous equation systems. To clarify, the single and simultaneous equation systems are discussed briefly indicating the difference between estimation methods. In the following section, the differences between single and simultaneous equation approaches are discussed

6.4.1.1 The Single Equation Model.

In a linear multiple regression model

$$Y_i = a_0 + a_1X_{1i} + a_2X_{2i} + \dots + a_nX_{ni} + u_i \quad (6.22)$$

where Y_i is dependent variable, X_i 's are independent variables, a_0 is the intercept, a_i 's are slope coefficients and u_i is the disturbance term.

The crucial assumption is that the variables are independent of the disturbance term. Here, X_i 's determine Y_i . There is a one way relationship between the X_i 's and Y_i and no feedback effect exists. The OLS estimators produce unbiased and efficient estimates of the parameters, subject to the errors in equation (6.22) being identically and independently distributed random errors.

6.4.1.2 The Simultaneous Equations Model

The following functional relationships can be considered as an example of a simple simultaneous equation model with two equations

$$Y_{1i} = a_{10} + a_{11}Y_{2i} + b_{11}X_{1i} + b_{12}X_{2i} + b_{13}X_{3i} + u_{1i} \quad (6.23)$$

and

$$Y_{2i} = a_{20} + a_{21}Y_{1i} + b_{21}X_{1i} + b_{22}X_{2i} + u_{2i} \quad (6.24)$$

where, Y 's are the endogenous variables; X 's are the exogenous variables; a_i 's, b_i 's are the structural parameters and u_i 's are disturbance terms.

In a simultaneous equation model, there are two types of variables, endogenous and exogenous. Endogenous variables (Y 's) are determined by the simultaneous interaction of the relations in the model, and the exogenous (or predetermined) variables (X 's) are determined outside the model. Here there is interdependence between Y_{2i} and Y_{1i} . The exogenous variables are assumed to be uncorrelated with the residuals u_i 's, but some correlation exists between the endogenous variables and the residuals. In this simultaneous equation system, the OLS estimator (based on a single equation approach) results in biased and inconsistent estimates of the structural parameters.

6.4.1.3 Identification Problem

It is not always possible to estimate the parameters of the structural equation from the reduced form. The problem whether the parameters of the structural equation can be found from the reduced form is called the identification problem. Once a structural equation system has been specified, the next step is to find whether the parameters are identified or not. After considering the identification problem, the next step is to choose a suitable estimation technique. The choice of estimation technique is quite important if there is more than one way to estimate the parameters given the reduced form. An equation is unidentified if there is no way of estimating all the structural parameters from the reduced form. An equation is identified if it is possible to find values of parameters from the reduced form of the system of equations. An equation is exactly identified if a unique parameter value exists and over identified if more than one value is obtained for the same parameter. It is quite possible, within a system of equations, that some equations are identified while some others are not.

A necessary condition (Order Condition) for identification for an equation is that the number of all variables excluded from the equation be greater than or equal to the number of endogenous variables in the model less one. According to Gujarati (1995)

In a model of m simultaneous equations in order for an equation to be identified, the number of predetermined variables excluded from the equation must not be less than the number of endogenous variables included in that equation less 1, i.e. $K-k \geq m-1$ ' (1995, p 665).

The sufficient condition (Rank Condition) for identification is that in a system of equations, any equation is identified if and only if it is possible to construct at least one non-zero determinant of order (the number of equations in the system less one) from that particular equation.¹⁰ According to Gujarati (1995)

In a model containing M equations in M endogenous variables, an equation is identified if and only if at least one non-zero determinant of order $(M-1)(M-1)$ can be constructed from the

¹⁰ The rank and order condition for the profit, concentration and conjecture model are checked in Chapter 9.

coefficients of the variables (both endogenous and predetermined) excluded from that particular equation, but included in the other equations of the model' (1995, p 667).

6.4.1.4 Estimation Techniques for the Simultaneous Equations Model

There are two different methods of estimation for simultaneous equation models, viz. single equation methods (alternatively called limited estimation technique) and simultaneous (multiple) equation methods.

In the single equation method, each equation is estimated separately considering information about the restrictions on the coefficient of that particular equation. The restrictions on the coefficients of the other equation are not considered. Commonly used single equation methods are instrumental variable technique (IV), two-stage least squares (2SLS), indirect least squares (ILS) and limited information maximum likelihood (LIML).

In multiple equation methods, all equations are considered simultaneously. Commonly used methods are full-information maximum likelihood method (FIML) and three-stage least squares (3SLS).

Two-stage least squares provides an estimation procedure to obtain the values of the structural parameters and is used frequently in an over identified system.¹¹ It uses the information available from the specification of a system of equations to obtain a unique estimate of each structural parameter. In the 2SLS, the exogenous variables, uncorrelated with the residuals are substituted for the endogenous variables. Estimates of the structural parameters are consistent.¹²

An estimation procedure, frequently used in empirical studies is three stage least squares, a method applicable to all equations of a system and gives estimates of all parameters

¹¹ Both for exactly and over identified system, the 2SLS and the IV technique yield equivalent parameter estimates for proof see Johnston (1972) section 13.2.

¹² Intuitively, the first stage of the 2SLS creates an instrument, and the second stage involves a variant of the IV estimation.

simultaneously. In 3SLS estimation, each equation is estimated with 2SLS. In the first stage, the reduced-form of the system is estimated. The fitted values of the endogenous variables are used to obtain 2SLS estimates for all equations in the system. Once the 2SLS parameters have been calculated, the residuals of each equation are used to estimate the cross-section variances and covariances. In the third stage, generalised least-squares parameter estimates are obtained. The 3SLS procedure can be shown to yield more efficient parameter estimates than 2SLS as it considers cross-equation correlation. For the 3SLS method, both the variables and their mathematical form are important in each equation. The random term of each equation should be serially independent and the random variables of the various relations of the system are contemporaneously dependent. If the random variables of the various relations are independent, the 3SLS reduces to 2SLS. Thus if one is not sure regarding the accuracy of the specification of the model and if it seems that the u 's (random variables) are not serially interdependent, then it is preferable to use 2SLS instead of 3SLS for estimating the parameters of a simultaneous equation system.

From the above discussion, it is clear that the estimation methods are different for the two approaches (viz. the single and the multiple equation approach). In practice, single equation methods are widely used particularly the IV, 2SLS techniques. The 2SLS and 3SLS techniques are used in the empirical analysis.

6.4.2 Diagnostic Tests Used in the Models

For any classical linear regression model (CLRM) like equation (6.22) the OLS estimators are best linear unbiased estimators (BLUE) with the following assumptions

a) Zero mean value of disturbance u_i

i.e. $E(u_i) = 0$, for all i .

Violation of this restriction yields biased estimates of the constant term.

b) Constant variance of u_i

i.e. $\text{var}(u_i) = \sigma^2$, for all i .

Violation of this restriction implies heteroscedasticity in disturbances, so that estimates are not efficient.

c) The regression model is correctly specified. Violation leads to biased estimates if omitted variables are correlated with included explanatory variables.

d) No perfect multicollinearity exists among the explanatory variables. Violation means the data matrix is singular and no estimates can be calculated.

e) Zero covariance between u_i and X_i , i.e. X_i is nonstochastic.

i.e. $\text{cov}(u_i, X_i) = 0$

Violation of this restriction causes simultaneity problem.¹³

f) No autocorrelation between the disturbances.

i.e. $\text{cov}(u_i, u_j) = 0$, for $i \neq j$

In the analysis, the presence of heteroscedasticity, specification error (if any) and the possibility of multicollinearity will be checked for the final version of each model, a brief theoretical discussion of these issues would be useful. The violation of restriction (e) is examined separately in Chapter 9. Autocorrelation is not relevant to cross-sectional analysis.

6.4.2.1 Heteroscedasticity

An important assumption of the CLRM is that the variance of each disturbance term u_i is constant. The problem of heteroscedasticity is common for cross sectional studies. In cross sectional data, heteroscedasticity can exist due to variation in size. In the presence of heteroscedasticity, parameter estimates are unbiased but no longer efficient (i.e., with minimum variance). In the heteroscedastic situation, what is clearly required is a method of weighting the

¹³Note violation of c) may lead to $\text{cov}(u_i, u_j) \neq 0$.

observations according to their relative importance regarding the information they convey about the true relationship.

It is clearly important to detect the presence of heteroscedasticity to get efficient estimates of the parameters. There are several diagnostic tests available e.g. Goldfeld and Quandt (1972), Breusch-Pagan- Godfrey (1979 and 1978), Park (1966) and White (1980). The Goldfeld and Quandt test imposes a formal structure on the nature of heteroscedasticity and requires reordering the observations with respect to the variable that supposedly caused, heteroscedasticity. Breusch-Pagan-Godfrey test is sensitive to the normality assumption. In the final version of each model, White's heteroscedasticity test is performed (as Shazam 7.0 computer program considers this test).

In a linear multiple regression model:

$$Y_i = a_0 + a_1X_{1i} + a_2X_{2i} + a_3X_{3i} + u_i \quad (6.25)$$

The White test proceeds as follows:

- a) The residuals u_i of regression (6.25) are obtained
- b) An auxiliary regression is considered regressing u_i^2 on the original value of regressors, squared values of regressors and the cross product (s) of regressors. i.e.

$$u_i^2 = \kappa_0 + \kappa_1X_{1i} + \kappa_2X_{2i} + \kappa_3X_{3i} + \kappa_4X_{1i}^2 + \kappa_5X_{2i}^2 + \kappa_6X_{3i}^2 + \kappa_7X_{1i}X_{2i} + \kappa_8X_{1i}X_{3i} + \kappa_9X_{2i}X_{3i} + v_i \quad (6.26)$$

- c) The χ^2 statistic is obtained as $n \cdot R^2$ (where n is sample size and R^2 is obtained from the auxiliary regression). Null hypothesis is there is no heteroscedasticity

and $n \cdot R^2_{\text{asy}} \chi^2_{df}$

where the degrees of freedom are the number of regressors in the auxiliary equation except constant term, i.e. in our example the degrees of freedom are 9. If the value obtained from test statistics is greater than critical value, the null hypothesis should be rejected, and there is heteroscedasticity.

6.4.2.2 The Ramsey's Regression Specification Error Test (RESET)

The proper functional form of a model is also important in estimating consistent parameters. Economic theory may provide predictions for the signs of the estimated parameters, but often does not provide a specific functional form of a model. Here, a widely used test, viz. RESET test by Ramsey (1969) is considered to identify specification error in the model.¹⁴

Suppose the original model is

$$Y_i = a_1 + \sum_k a_k X_{ki} + u_i \quad (6.27)$$

Step 1: Obtain the estimated Y_i i.e. $Y_{i(\text{hat})}$

Step 2: Rerun (6.27) with the powers of predicted values of the original regression as additional regressors.

$$Y_i = a_1 + \sum_k a_k X_{ki} + \sum_j b_j (Y_i)^j + u_i \quad (6.28)$$

usually, $j=2 \dots r$. The null hypothesis, i.e. there is no specification error, i.e. $b_2 = \dots = b_r = 0$ is tested using F-test:

$$\text{where } F = \frac{(R^2_{\text{NEW}} - R^2_{\text{OLD}}) / \text{number of newregreeors}}{(1 - R^2_{\text{NEW}}) / (n - \text{number of parameters in the new model})}$$

¹⁴ A good summary of specification tests can be found McAleer (1986).

Step 3: If the computed $F > F_{\alpha, p, q}$, where p =number of new regressors, q =n-number of parameters in the new model, then the conclusion can be drawn that the model is mis-specified.

6.4.2.3 Multicollinearity

Observations on economic variables are not generated under controlled experiments like physical science. As a result, there is always some general interrelation between the explanatory variables. An important assumption of the CLRM is that no exact or perfect relationships exist between explanatory variables. For practical purposes, multicollinearity as less than perfect is considered, i.e. explanatory variables are highly collinear. In this situation OLS estimates have larger standard errors and low t-ratios, so that they can not be estimated with great precision. Since multicollinearity is a sample phenomenon, there is no formal method of testing its strength (see Kmenta (1986, pp 431)).

i) Examining Partial Correlations

Farrar and Glauber (1967) use partial correlation coefficients. However, this method is criticised by O'Hagan and McCabe (1975).

ii) Auxiliary Regressions, Klien's Rule of Thumb

According to Klein (1962) test, regress each independent variable against all other independent variables. These are called auxiliary regressions. Find the R^2_i for each auxiliary regressions. Compare R^2_i with the R^2 of the original regression, i.e. Y on X 's. If R^2_i is greater than R^2 , multicollinearity exists.

6.5 Conclusions

In this chapter measures of variables with a description of the data base are presented. Also the estimation techniques with econometric tests applied in the analysis are described. The next task is to present the empirical findings from the profits, concentration and conjectures models. This is done in Chapter 7 and 8. In the next chapter, findings from the profit models (with different versions) are explained.

CHAPTER 7

THE PROFIT MODELS: EMPIRICAL FINDINGS

7.1 Introduction

The theoretical derivation of profit models is presented in Chapter 4. In this chapter the findings from estimating these profit models are considered. First, findings from the short-run equilibrium profit model are considered with different versions. In this respect, section 7.2 compares the findings between the linear and logarithmic functional forms. In section 7.3, the importance of major criticisms against the structure-conduct-performance studies are examined with the logarithmic version of the profit model. Section 7.4 firstly, examines how the profit-concentration relationship may differ between consumer and producer goods industries. Secondly, the findings from the final version of the profit model are compared with an *ad hoc* version (both are in the logarithmic functional form).

In section 7.5, findings from the disequilibrium model (in both the linear and logarithmic functional form) are considered. Here, the annual rate of adjustment of profit (towards its equilibrium) is calculated for the seven-year period. Finally, section 7.6 adds some concluding remarks.

7.2 Empirical Results of the Short-run Equilibrium Profit Model

To compare the findings, the equilibrium profit model is estimated in two functional forms: i) all variables are in linear form and ii) all variables except CPD are in logarithm form. The equation numbers from Chapter 4 are noted in the discussion. In Table 7.1, column 1 and 2 show the results of the profit model with linear (equation 4.26') and logarithmic (equation

4.26) functional form, respectively. All variables have the expected sign, except CPD which is insignificant in both cases.¹

Table 7.1: Results of the Profit Model, 1984/85

Independent Variables	Linear Functional Form (Equation Number 4.26')	Logarithmic Functional Form (Equation Number 4.26)
H	0.053 (0.82)	0.266 ^a (2.95)
ELAS _{own}	-0.020 ^c (1.57)	-0.330 ^a (3.46)
CONJ	0.003 ^a (3.78)	0.286 ^a (3.16)
CPD	-0.004 (0.68)	-0.018 (1.04)
IMP1	-0.004 (0.32)	-0.015 (1.22)
INVS	0.767 ^a (4.33)	0.073 ^b (1.84)
Intercept	0.108	-0.590
R ² (adjusted)	0.195	0.362
F-Ratio	4.82 ^a	10.55 ^a
RESET(3)(d)	0.457	5.78 ^a

Note: Gross margin on sales (GPMT0) as the dependent variable.

For Column 2, except CPD all variables are in logarithmic functional form.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

F value at (6, 95) degrees of freedom is 2.96 at the 0.01 level for F-test.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.1 level using a one-tailed t-test.

(d) Ramsey's regression specification test statistic follows F distribution where critical F is $F_{0.01,3,92}=3.95$.

The coefficient of H-index is positive in both cases, but significant at the one percent level only with the logarithmic functional form profit model. ELAS_{own} is significant at the ten percent level for the linear functional form and at the one percent level for the logarithmic functional form with expected negative sign. The coefficient of CONJ is positive and significant at the one percent level in both cases. IMP1 is negative and insignificant.² INVS is positive and

¹ Phillips (1978) also finds an insignificant negative relationship between price-cost margins and CPD for the sales based measure of profit (1978, pp309).

² Ratnayke (1990) findings also emphasises that trade variables are insignificant in explaining profits of Australian manufacturing industries, possibly due to the lack of international integration.

significant at the one percent level for the linear functional form model and significant at the five percent level for the logarithmic functional form model. The logarithmic functional form is used for further analysis in section 7.3 and section 7.4.³

The standard diagnostic tests are performed for the profit model for both the linear and logarithmic functional form. From Table 7.1, we can conclude that standard RESET specification test rejects the null hypothesis that there is no specification error in the model for the logarithmic specification.⁴ The multicollinearity problem has been checked using the auxiliary equation approach, discussed in section 6.4.2.3. There is no evidence of multicollinearity in general. Also Tables 7.2 and 7.3 provide the correlation matrix of the variables for the linear (equation 4.26') and logarithmic (equation 4.26) functional form model, respectively.

Table 7.2: Correlation Matrix of Variables for the Profit Model in Linear Functional Form

Variables	GPMTO	H	ELAS _{own}	CPD	IMP1	CONJ	INVS
GPMTO	1.000						
H	0.190	1.000					
ELAS _{own}	-0.064	-0.052	1.000				
CPD	-0.124	-0.169	-0.002	1.000			
IMP1	-0.136	-0.026	0.264	0.084	1.000		
CONJ	0.122	-0.235	0.430	-0.009	0.138	1.000	
INVS	0.446	0.339	-0.016	-0.107	-0.226	-0.034	1.000

³ Also the logarithmic functional form is preferred theoretically.

⁴ Although the RESET test for the logarithmic specification of the disequilibrium version is not significant and shows no specification error in the model, see Table 7.11.

Table 7.3: Correlation Matrix of Variables for the Profit Model in Logarithmic Functional Form

Variables	GPMTO	H	ELAS _{own}	CPD	IMP1	CONJ	INVS
GPMTO	1.000						
H	0.164	1.000					
ELAS _{own}	-0.066	-0.056	1.000				
CPD	-0.154	-0.135	-0.053	1.000			
IMP1	-0.133	0.018	0.192	0.052	1.000		
CONJ	0.090	-0.601	0.719	0.012	0.147	1.000	
INVS	0.408	0.342	-0.009	-0.139	-0.309	-0.069	1.000

Note: Except CPD all variables are in logarithmic functional form.

7.3 Testing the Major Criticisms against the Structure-Conduct-Performance Studies

In Chapter 2, the major criticisms against the existing structure-conduct-performance literature are discussed, and it is noted that conceptual problems and statistical error may obscure relationships among the structure-conduct-performance variables. Estimates of the profit model with the logarithmic functional form between the gross margin and the variables on the R.H.S. of equation (4.26) obtained through application of the ordinary least squares (OLS) regression are unbiased and efficient only if strict assumptions hold for a disturbance term added to the R.H.S. These assumptions can be invalidated by any of the following problems:

- i) the omission of relevant explanatory variables,
- ii) measurement errors
- iii) aggregation bias in data set
- iv) simultaneous causality⁵
- v) mis-specification due to the functional form of the model⁶

⁵ Simultaneous causality is considered in Chapter 9.

These possible problems are examined below with the data.

7.3.1 Problem Due to the Omission of Relevant Explanatory Variables

The results in Table 7.4 show the estimated effects of explanatory variables on the gross profit margin on sales (GPMT0). The logarithmic functional form profit model is taken into account. Results are presented with five separate regressions, so that the effect of omitting relevant variables from the regression analysis can be examined.

In regression 1 of Table 7.4, only H is considered as an explanatory variable. H is positive and significant at the five percent level and the adjusted R^2 is 0.017. Regression 2 presents results for the Cowling-Watson model with Cournot behaviour, i.e. when $CONJ=0$, $PCM=H/ELAS_{own}$, a special case of equation (4.4). The coefficients of H and $ELAS_{own}$ are with proper signs, while only H is significant at the five percent level. The adjusted R^2 is 0.010. In regression 3, the results of the simple profit model are shown, which is represented by equation (4.4). All variables are with expected signs and significant at the one percent levels. The adjusted R^2 is 0.326. In regression 4, the results of the profit model with heterogeneous products are shown, which is represented in equation (4.18). Except CPD , all variables are with expected signs and significant at the one percent level. The adjusted R^2 is 0.343. Finally, regression 5 represents the final version of profit model represented in equation (4.26). Except CPD (which is insignificant again), all other variables have the expected sign. H , $ELAS_{own}$ and $CONJ$ are significant at the one percent level, while $INVS$ is significant at the five percent level. The adjusted R^2 is 0.362.

The results in Table 7.4 suggest that the omission of relevant explanatory variables is important to the specification and testing of the structure-conduct-performance relationships in Australian manufacturing. The magnitude and statistical significance of the

⁶This is discussed in previous section.

Table 7.4: Results of the Effects of Adding Relevant Explanatory Variables on Profit-Concentration Relationship, 1984/85

Equation Number	Intercept	H	ELAS _{own}	CONJ	CPD	IMP1	INVS	R ² (adjusted)	F-ratio
1.	-0.845	0.055 ^b (1.79)	-	-	-	-	-	0.017	-
2.	-0.856	0.054 ^b (1.74)	-0.020 (0.59)	-	-	-	-	0.010	-
3.	-0.661	0.314 ^a (3.60)	-0.368 ^a (3.92)	0.317 ^a (3.53)	-	-	-	0.326	-
4.	-0.649	0.310 ^a (3.37)	-0.373 ^a (3.74)	0.321 ^a (3.33)	-0.023 ^c (1.33)	-	-	0.343	-
5.	-0.590	0.266 ^a (2.95)	-0.330 ^a (3.46)	0.286 ^a (3.16)	-0.018 (1.04)	-0.015 (1.22)	0.073 ^b (1.84)	0.362	10.55(d)

Note: GPMTO as the dependent variable.

Except CPD, all variables are in logarithmic functional form.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.10 level using a one-tailed t-test.

(d) F (6, 95) is 2.96 at the 0.01 level.

estimated coefficient of the concentration variable depends on the set of included variables. The magnitude and t-ratio of concentration in explaining profit variation across industries is greatest for the simple model, regression 3, that is based directly on the Cowling and Waterson (1976) analysis with different conjectures.

A weakness with the results for the Cowling and Waterson analysis is that the estimated coefficients are each significantly different from the expected unitary value. The estimated coefficients in regression 3 of Table 7.4 are each substantially less than the unitary value predicted by the Cowling and Waterson (1976) analysis. Further the value of the adjusted R^2 is low. While the adjusted R^2 value increases with the addition of explanatory variables suggested by extensions to the simple model, it is still only 0.362 suggesting the possibility of further omitted variables. Further extension of the model seems warranted to capture additional influences on industry-level profitability.

7.3.2 Measurement Error

Cross-section studies also fail to be persuasive due to the measurement error. Measurement error in explanatory variables has been well recognised in the structure-conduct-performance studies as a potential source of downward bias in estimates. Due to limited data availability, there is not much scope to measure all explanatory variables differently. However, the effect of measurement errors in key variables is examined with the profit and model. The equation (4.26). is re-estimated with alternative measures of profit and concentration separately.

7.3.2.1 Alternative Measures of Profits

Canyon and Machin (1991) suggest that measurement error in the dependent variable may lead to downward bias in the estimated effect of concentration on profitability.⁷ They find that, with

⁷ Phillips (1978) also finds different profit-concentration relationships using alternative measures of profits for Australian manufacturing, discussed in Chapter 2.

U.K. manufacturing data, a positive relationship exists between concentration and profitability when the profit margin is deflated by value added, instead of sales.⁸

The two columns of Table 7.5 show the results using the ratio of gross profits to sales (GPMTO) and gross profits to value added (GPMVA) as the dependent variable. All variables have the same sign as the profit model with GPMTO as the measure of profits. CPD is still opposite to the expected sign and insignificant. The significance level of $ELAS_{own}$ and CONJ coefficients is lower and INVS coefficient becomes insignificant. Also IMP1 is now significant at the one percent level.

Table 7.5: Results of the Profit Model with Alternative Measures of Profits, 1984/85

Dependent Variable	GPMTO	GPMVA
H	0.266 ^a (2.95)	0.217 ^a (2.72)
$ELAS_{own}$	-0.330 ^a (3.46)	-0.174 ^b (2.12)
CONJ	0.286 ^a (3.16)	0.130 ^b (1.73)
CPD	-0.018 (1.04)	-0.005 (0.27)
IMP1	-0.015 (1.22)	-0.043 ^a (3.06)
INVS	0.073 ^b (1.84)	0.008 (0.15)
Intercept	-0.590	-0.326
R^2 (adjusted)	0.362	0.186

Note: All variables except CPD are in logarithmic functional form and results are for equation (4.26).

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

⁸ Profits on sales does not take proper account of differences in the degree of vertical integration across industries.

The adjusted R^2 decreases to 0.186 using GPMVA as the measure of profitability from 0.362 using GPMTO as the profit measure. The results are stronger with GPMTO as the dependent variable. However, the results for the GPMVA measure more closely fit the predictions of the oligopoly model. The IMP1 variable is significant with predicted negative coefficient with the GPMVA measure. The findings support the importance of the choice of profit measure in explaining the profit-concentration relationship in Australian manufacturing.

7.3.2.2 Alternative Measures of Concentration

Although theoretically, the H-index is a proper measure of concentration for the hypothesised profit model, here the four-firm concentration ratio (CR4) is used as an alternative concentration index. In Table 7.6 column 1 and 2 shows the regression results using H-index and CR4 respectively, as alternative measures of concentration. The concentration coefficient is still positive, but loses its significance with CR4 measure. $ELAS_{own}$, CONJ and INVS are with expected signs in both cases. The coefficients of $ELAS_{own}$, CONJ are significant at the one percent level for both measures, while INVS coefficient has increased its significance at the one percent (from the five percent) level with the CR4 measure. IMP1 coefficient is with positive sign but still insignificant (like using H-index measure) with CR4 measure. R^2 (adjusted) is also higher 0.362 when H-index is considered compared to 0.200 with CR4. The findings again reflect the importance of measurement errors in explaining the SCP relationships. Most importantly, concentration is no longer a significant factor in explaining profits when CR4 is used as an index of structure instead of H-index.

7.3.2.3 Problem Due to the Aggregation Bias in Data Set

An implicit assumption of various structure-profitability hypotheses is that the industries are economically meaningful. Although the data set is at the ASIC four-digit level, the most disaggregated level available for the Australian industries, the industry classification

Table 7.6: Results of the Profit Model with Alternative Measures of Concentration, 1984/85

	Column 1	Column 2
H	0.266 ^a (2.95)	-
CR4	-	0.010 (1.10)
ELAS _{own}	-0.330 ^a (3.46)	-0.118 ^a (2.76)
CONJ	0.286 ^a (3.16)	0.091 ^a (3.91)
CPD	-0.018 (1.04)	-0.024 (1.15)
IMP1	-0.015 (1.22)	0.005 (0.38)
INVS	0.073 ^b (1.84)	0.178 ^a (4.11)
Intercept	-0.590	-0.633
R ² (adjusted)	0.362	0.200

Note: GPMTO as the dependent variable

Except CPD, all variables are in logarithmic form.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

may not represent the boundaries of economically meaningful markets.⁹ Also, the Cowling-Watson type oligopoly equilibrium models assume each firm operates at its expected market share. But in reality, actual share deviates from expected share. Bloch (1994), with Canadian data, suggests limiting samples to industries with low values of coefficient of variation of firm size, which can be used as a proxy measure of both aggregation and disequilibrium (for derivation see Bloch (1994, pp 77-81)).

Following Bloch (1981,1994) the coefficient of variation of firm size is used as a measure of market aggregation.¹⁰ In order to investigate the relationship among profitability,

⁹ The four-digit data could be far from ideal as these assume industries are serving in the national market only. In reality, for many products there exists a regional market rather than a national one.

¹⁰ The squared coefficient of variation of firm size is calculated using the formula: $V_X = [N^2(N-1)][H-1/N]$; where V_X is coefficient of variation of firm size, N is number of firms and H is industry Herfindahl index. Dividing the full sample of 58 industries into four groups according to their lowest value of variance of relative firm size Bloch (1981) finds the effect of concentration on profitability is strongly significant for the sub sample where the variance of relative firm size is lowest. Bloch (1994) ranks the industries with various sub samples and shows the results for the smallest sub samples are least affected by aggregation bias (Table 2, pp 80).

concentration and other variables, the model is re-estimated with 102 industries where industries are ranked according to the lowest value of the coefficient of variation of firm size and divided into four sub samples of approximately equal size. Table 7.7 presents the results of full sample and four sub samples (Class I to IV).

Both profit measures, viz. GPMTO and GPMVA are used here. The results show the effect of the coefficient of variation of firm size on profit-concentration relationship. For both profit measures, concentration coefficients and corresponding t-ratios are largest for the sub sample with lowest value of coefficient of variation of firm size. The estimated coefficient of concentration for the GPMTO regression in the sub sample with lowest coefficient of variation of firm size is more than three times as large as the corresponding coefficient for the full sample. Also for the GPMVA regression in the sub sample with lowest coefficient of variation of firm size, the estimated coefficient of concentration is nearly three times as large as the corresponding coefficient for the full sample. On the other hand, for both profit measures, concentration coefficients and corresponding t-ratios are lowest for the sub sample with highest value of coefficient of variation of firm size. For all sub samples, significant explanatory variables (except CPD) have coefficients that are correctly signed and similar to the results of full sample.

It is important to note that the magnitudes of coefficients for the lowest variance sub sample confirm exactly to Cowling-Watson model. As using joint test for coefficients we found F statistic = 0.196 (using GPMTO as the dependent variable) and 3.44 (using GPMVA as the dependent variable). In both cases we cannot reject the hypothesis as $F_{0.01,3,18} = 5.09$ is the critical value. Therefore the prediction that H and CONJ coefficients are equal to 1 and ELAS_{OWN} equal to -1 cannot be rejected.

Table 7.7: Regression Results with the Sub Samples of Industries with
Lowest Coefficient of Variation of Firm size, 1984/85

Dependent Variable	Intercept	H	ELAS _{own}	CONJ	CPD	IMP1	INVS	R ² (adjusted)	No. of Industries
Full Sample of Industries									
GPMTO	-0.590	0.266 ^a (2.95)	-0.330 ^a (3.46)	0.286 ^a (3.16)	-0.018 (1.04)	-0.015 (1.22)	0.073 ^b (1.84)	0.362	102
GPMVA	-0.326	0.217 ^a (2.72)	-0.174 ^b (2.12)	0.130 ^b (1.73)	-0.005 (0.27)	-0.043 ^a (3.06)	0.008 (0.15)	0.186	102
Class I : Sub Sample with Lowest Coefficient of a Variation of Firm Size									
GPMTO	-0.065	0.938 ^a (7.96)	-0.913 ^a (6.05)	0.940 ^a (7.56)	-0.087 ^a (2.89)	0.007 (0.28)	-0.038 (0.61)	0.669	25
GPMVA	0.029	0.600 ^a (4.69)	-0.496 ^a (2.64)	0.517 ^a (3.21)	-0.069 ^b (2.14)	-0.094 ^a (3.54)	-0.020 (0.19)	0.450	25
Class II : Sub Sample with Next to Lowest Coefficient of a Variation of Firm Size									
GPMTO	-0.850	0.172 ^a (2.74)	-0.336 ^a (3.99)	0.235 ^a (4.38)	-0.002 (0.08)	-0.059 ^b (1.80)	0.020 (0.29)	0.365	25
GPMVA	-0.489	0.194 ^b (2.48)	-0.118 (1.21)	0.085 ^c (1.42)	0.016 (0.33)	-0.052 ^c (1.66)	-0.082 (1.09)	-0.004	25

Table 7.7: Regression Results with log-linear Model for the Sub Samples of Industries with Lowest Coefficient of Variation of Firm size, 1984/85 (Contd.)

Dependent Variable	Intercept	H	ELAS _{own}	CONJ	CPD	IMP1	INVS	R ² (adjusted)	No. of Industries
Class III : Sub Sample with Next to Highest Coefficient of a Variation of Firm Size									
GPMTO	-0.365	0.295 ^a (2.73)	-0.380 ^a (2.70)	0.335 ^a (3.02)	-0.041 ^c (1.30)	0.017 (1.07)	0.169 ^a (2.66)	0.448	26
GPMVA	-0.078	0.342 ^a (4.67)	-0.314 ^a (3.60)	0.244 ^a (4.05)	0.027 (1.08)	-0.016 ^c (1.28)	0.108 ^c (1.34)	0.344	26
Class IV : Sub Sample with Next to Highest Coefficient of a Variation of Firm Size									
GPMTO	-0.803	0.124 ^c (1.50)	-0.298 ^a (4.38)	0.172 ^b (2.27)	-0.046 ^a (2.57)	0.008 (0.59)	0.030 (0.56)	0.387	26
GPMVA	-0.527	0.051 (0.19)	-0.151 (0.90)	0.023 (0.09)	-0.017 (0.49)	-0.016 (0.37)	0.007 (0.08)	-0.093	26

Note: Figures in parentheses are White's heteroscedastic consistent t-ratios.

Except CPD, all variables are in logarithmic form.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.10 level using a one-tailed t-test.

In summary, the findings are more or less consistent with the Canadian study and establishes the possibility of misstatement in explaining the profit-concentration relationships due to the presence of aggregation bias.¹¹

7.4 Structure-Performance Relationships: Other Considerations

In this section, firstly the differences in structure-performance relationship (if any) are examined between consumer and producer goods industries within the sample. Then, the findings from the profit model of equation (4.26) are compared with the findings from an *ad hoc* version.

7.4.1 Presence of Consumer/Producer Goods Industries

Product differentiation could be an important source of margin differences among industries. The degree of product differentiation is measured in terms of cross price elasticity of demand for competing products. Producer goods are less differentiated, so their markets are characterised by greater knowledge and buying power from the buyers.¹² Therefore, a narrower range of price discretion can be expected from sellers, compared to the consumer goods market with the same level of concentration.¹³

In Table 7.8 industries are divided into consumer and producer goods. Repeating the regression analysis for the full sample and for these two groups of industries in logarithmic functional form findings are explained here. The regression coefficient and t-ratio for concentration is higher for consumer than for producer goods industries. The value of adjusted R^2 is 0.540, which is much higher for the consumer goods industries compared to the producer goods industries.¹⁴

¹¹ For Australia, Round (1980a) considers this issue in a different way. He estimates the same profit equation with three-digit and four-digit data, and finds that the more disaggregated four-digit data weakens the concentration-profit relationship.

¹² Advertising is a major source of product differentiation. Advertising as an entry barrier affects the consumer goods industries more than producer goods industries. In the profit model, product differentiation is introduced as a demand characteristic affecting margins rather than as a source of entry barrier.

¹³ Differentiated product makes seller's demand curve less elastic, therefore provides a seller some degree of discretion with respect to pricing policies.

¹⁴ The finding supports Phillips (1978) who finds the effect of concentration on margins is strongest and most significant for consumer goods industries at the four-digit level ASIC data.

Table 7.8: Results of the Profit Model with Consumers and Producers Goods Industries, 1984/85,
GPMTO as the Dependent Variable

Industry Group, No. of Industries	Intercept	H	ELAS _{own}	CONJ	IMP1	INVS	R ² (adjusted)	Average Margins	Average Concentration
All Industries (102)	-0.845	0.055 ^b (1.79)	-	-	-	-	0.017	0.127	0.092
	-0.591	0.271 ^a (3.05)	-0.330 ^a (3.40)	0.288 ^a (3.24)	-0.015 ^c (1.28)	0.076 ^b (1.93)	0.362		
Consumer Goods Industries (52)	-0.831	0.078 ^c (1.59)	-	-	-	-	0.029	0.123	0.082
	-0.408	0.494 ^a (5.55)	-0.557 ^a (6.13)	0.508 ^a (6.05)	-0.015 (0.81)	0.073 ^b (1.88)	0.540		
Producer Goods Industries (50)	-0.868	0.020 (0.51)	-	-	-	-	-0.016	0.132	0.102
	-0.764	0.205 ^a (2.90)	-0.273 ^a (2.73)	0.223 ^a (3.23)	-0.027 ^c (1.41)	0.005 (0.08)	0.230		

Note: Figures in parentheses are White's heteroscedastic consistent t-ratios.

Except CPD, all variables are in logarithmic functional form.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.10 level using a one-tailed t-test.

7.4.2 Comparison of the Profit Model with an *ad hoc* Version

To compare the findings from the oligopoly equilibrium profit model, an alternative version is considered from the standard literature.¹⁵ Table 7.9, compares the findings from the hypothesised profit model (given in equation 4.26) with an *ad hoc* version (given in equation 7.1 below). The *ad hoc* version considered is

$$\text{GPMTO} = f(\text{H, INVS, CPD, GROW, MESCDR, EXP, IMP1}) \quad (7.1)$$

The reasons for including H, INVS, CPD and IMP1 into the profit equation are as described before. The coefficients for H, INVS and CPD should be positive while the expected coefficient for IMP1 is negative.¹⁶ The effect of growth in sales (GROW) on the profit margins on sales is ambiguous.¹⁷ Profit margins should be higher with high barriers to entry. MESCDR is used as a proxy for entry barriers, which incorporates economies of scale in production as well as cost disadvantage of the smaller firms. Finally, export intensity (EXP) is included into the equation, the coefficient could be positive or negative (see Lyons (1981)).

The regressions are estimated in the logarithmic functional form with same sample for 1984/85 and GPMTO is used as the dependent variable. In Table 7.9, the findings from the hypothesised profit model based on oligopoly theory (equation (4.26)) are compared with the findings from the *ad hoc* version (equation (7.1)) in column 1 and 2 respectively. For the *ad hoc* version, the coefficient of H is no longer significant. Only INVS coefficient has improved its significance level from five to one percent. GROW is significant at the five percent level. MESCDR and EXP coefficients are insignificant. IMP1 variable is still insignificant, but with opposite sign. Also the adjusted R^2 is 0.144 for the *ad hoc* version compared to 0.362 for the hypothesised profit model based on oligopoly theory. The comparison of the findings from

¹⁵ This is termed as an *ad hoc* version as this is not derived directly from theory.

¹⁶ ELAS_{OWN} and CONJ are not included as these variables are not considered in most of the studies.

¹⁷ Growth in sales (GROW) increases demand or decreases costs or both. Decrease in costs will increase margins directly, while increase in demand will do the same via an increase in product prices or improving capacity utilisation. However, in oligopolistic industries, higher growth may induce firms to increase market shares by reducing prices. This will cause a negative relationship as suggested by Caves (1972).

these two models suggests that the oligopoly based profit model given in equation (4.26) is superior in explaining the structure-conduct-performance relationships for Australian manufacturing industries.¹⁸

Table 7.9: Comparison of the Findings from the Oligopoly Based Profit Model with an *ad hoc* Version

	Oligopoly Based Model (Equation (4.26))	An <i>ad hoc</i> Version (Equation (7.1))
H	0.266 ^a (2.95)	0.012 (0.42)
ELAS _{own}	-0.330 ^a (3.46)	-
CONJ	0.286 ^a (3.16)	-
INVS	0.073 ^b (1.84)	0.158 ^a (3.45)
CPD	-0.018 (1.04)	-0.014 (0.67)
GROW	-	-0.002 ^b (1.73)
MESCDR	-	0.005 (0.35)
EXP	-	-0.024 (1.25)
IMP1	-0.015 (1.22)	0.009 (0.52)
Intercept	-0.590	-0.639
R ² (adjusted)	0.362	0.144

Note: Except CPD, all variables are in logarithmic functional form.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

7.5 Findings from Disequilibrium Profit Models

In following section, we consider the findings from estimating disequilibrium profit models for the linear functional form, and logarithmic functional form respectively.

¹⁸ The *ad hoc* version may not be a complete model, researchers have used various explanatory variables in the literature. Here only some standard variables from literature are taken into account.

7.5.1 Linear Functional Form

Both the linear and logarithmic functional forms (equation (4.27') and (4.27.1), respectively) are considered, where the adjustment coefficient of profit towards equilibrium is constant over time. For both versions, a regression for a the profit model without dynamic adjustment is provided in column 1 of the corresponding tables. Table 7.10 compares the findings from the disequilibrium model with equilibrium version when both are in linear form. In the equilibrium version, i.e. column 1 or equation (4.26'), the estimated H and IMP1 coefficients are insignificant with expected signs. CONJ and INVS are significant at the one percent level and ELAS_{own} is significant at the ten percent level with expected signs. CPD is insignificant and with opposite sign. The adjusted R^2 is 0.195.

Column 2 describes the results of the disequilibrium model (equation (4.27')) when μ' is constant. Here GPMTO84 is considered as the dependent variable, so that the results can be compared with the equilibrium model and with other studies that do not employ a dynamic adjustment model of profits. The coefficient of the lagged gross profit margin in this regression provides an estimate of $(1-\mu')$. This coefficient of lagged margin in Table 7.10 is significantly greater than zero and less than one at the five percent significance level using a one-tailed t test. Apart from H (which is still insignificant and with opposite sign), all coefficients are with similar signs as in the corresponding equilibrium model. R^2 (adjusted) is 0.252, nearly 6.0 percent higher than the equilibrium model (column 1). Also the RESET test shows, like equilibrium model, there is no specification error in the disequilibrium model. The implied estimate of the annual speed of adjustment of profits is about 19.7 percent.¹⁹ The formula for the calculation of annual adjustment of profit is given in Appendix III.

¹⁹It is not possible to compare directly the adjustment coefficient of profit with overseas studies, as none of these try to find this value. Also our model is based on short-run model, which is different from others.

Table 7.10: Findings from the Equilibrium Model is Compared with the Disequilibrium Version

	Column 1 (Equation Number 4.26')	Column 2 (Equation Number 4.27')
GPMTO ₇₇	-	0.215 ^b (1.91)
H	0.053 (0.82)	-0.012 (0.22)
ELAS _{own}	-0.020 ^c (1.57)	-0.021 ^c (1.60)
CONJ	0.003 ^a (3.78)	0.003 ^a (4.25)
CPD	-0.004 (0.68)	-0.002 (0.41)
IMP1	-0.004 (0.32)	-0.007 (0.58)
INVS	0.767 ^a (4.33)	0.778 ^a (4.40)
Intercept	0.108	0.072
R ² (adjusted)	0.195	0.252
F-ratio	4.82 [*]	5.90 [*]
RESET (3)d	0.457	1.730

Note: Both models are in linear functional form

GPMTO₈₄ is used as the dependent variable

All variables are without logs.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.10 level using a one-tailed t-test.

*F value at (6,95) degrees of freedom is 2.96 at the 0.01 level for F-test.

d Ramsey's regression specification test follows F distribution where critical F is $F_{0.01,3,91}=3.95$.

7.5.2 Logarithmic Functional Form

Table 7.11 compares the equilibrium and disequilibrium results when both models are in logarithmic functional form (equation (4.26) and (4.27.1) respectively). Column 1 describes the findings of equilibrium model. All variables except CPD are with expected signs. H, ELAS_{own}, CONJ are significant at the one percent level and INVS is significant at the five

percent level. Results are more or less the same for the disequilibrium version (i.e. equation (4.27.1) and shown in column 2), only IMP1 is also significant here at the ten percent level with expected sign. The coefficient of lagged margin is again significantly greater than zero and less than one at the five percent significance level using a one-tailed t test. R^2 (adjusted) is 0.400, nearly four percent higher than the equilibrium model. Contrary to the equilibrium model, RESET test here shows no specification error in the disequilibrium model. The implied estimate of the annual speed of adjustment of profits is about 11.2 percent. The formula for the calculation of annual adjustment of profit is given in Appendix IV.

It is interesting to note the effect that introducing a dynamic specification of profit adjustment has on the estimated coefficients of the equilibrium profits relationship. The magnitude of the estimated coefficients should be altered to reflect the fact that they now provide estimates of μ times the original coefficients, but the sign of the coefficients would not be expected to change unless at least one of the profits model is mis-specified. In this respect, the disequilibrium model in the logarithmic functional form performs best. Here, all variables except CPD are with expected signs and same as the equilibrium model. Also except CPD, all variables are significant at least at the ten percent level.

7.6 Concluding Remarks

In this chapter, firstly, the structure-conduct-performance relationships are estimated with a short-run equilibrium profit model derived from oligopoly theory with different versions. The profit model with the logarithmic functional form is used to examine major criticisms directed at profit-concentration studies. The results provide some support for each of the criticisms.

In particular, the results support the view that the omission of explanatory variables may result in a biased relationship between concentration and profitability. The choice of the measure of profitability used as the dependent variable also appears to be important. The profit model with GPMVA as the dependent variable performs better in terms of expected signs. Also when CR4 is used as an alternative measure of concentration instead of the H index, concentration appears to be insignificant (still positive) in explaining profit.

Table 7.11: Findings from the Equilibrium Model Compared with the Disequilibrium

Version

	Column 1 (Equation Number 4.26)	Column 2 (Equation Number 4.27.1)
GPMT0 ₇₇	-	0.217 ^b (1.95)
H	0.266 ^a (2.95)	0.258 ^a (2.94)
ELAS _{own}	-0.330 ^a (3.46)	-0.101 ^a (3.85)
CONJ	0.286 ^a (3.16)	0.288 ^a (3.26)
CPD	-0.018 (1.04)	-0.014 (0.86)
IMP1	-0.015 (1.22)	-0.018 ^c (1.55)
INVS	0.073 ^b (1.84)	0.060 ^b (1.67)
Intercept	-0.590	-0.470
R ² (adjusted)	0.362	0.400
F-Ratio	10.55 [*]	12.60 [*]
RESET(3)d	5.78 ^a	2.61

Note: Both models are in logarithmic functional form

GPMT0₈₄ is used as the dependent variable

Except CPD, all variables are measured in logarithmic functional form.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.10 level using a one-tailed t-test.

*F value at (6,95) degrees of freedom is 2.96 at the 0.01 level for F-test.

d Ramsey's regression specification test follows F distribution where critical F is $F_{0.01,3,91}=3.95$.

Secondly, some other issues, viz. the presence of aggregation bias and the presence of consumer-producer goods in explaining profit-concentration relationship are considered. The findings more or less support the view that the presence of aggregation bias weakens the structure-conduct-performance relationships. Also the profit-concentration relationship is found to be stronger for consumer goods industries rather than producer goods industries. The results from the oligopoly based model is compared with an *ad hoc* version of profit model,

and the comparison establishes that the oligopoly based profit model is superior than the *ad hoc* version in terms of explanatory power and significance level.

Finally, a reduced form disequilibrium model is considered with both linear and logarithmic functional form, where adjustment of profits is assumed to be constant over a seven year period for Australian manufacturing industries. Results are broadly consistent with other studies in this area. Most of the signs are similar to the non-dynamic model. Initial profits are found to be significant with positive effect on profits with both versions of disequilibrium model.²⁰ The disequilibrium profit model in logarithmic functional form performs better in terms of signs and significance level. The expected annual rate of adjustment of profit is 11.2 percent. In the next chapter, the empirical findings from the concentration and industry conjectures models are discussed separately.

²⁰ A variable adjustment model of disequilibrium profit model is considered, where adjustment of profits depends on some barriers to entry. The dynamic aspects of the variable adjustment model are not found to be prominent. Hence detailed results are not presented here. In this respect, longitudinal data is desirable. The lack of systematic longitudinal data for Australian manufacturing does not allow us to perform a study of the persistence of profits like Mueller (1977,1983,1985), Cubbin and Geroski (1987) and others.

CHAPTER 8

THE CONCENTRATION AND CONJECTURES MODELS: EMPIRICAL FINDINGS

8.1 Introduction

This chapter contains the empirical findings from different versions of concentration and conjectures models. The theoretical discussion is presented in Chapter 5. First, the findings from concentration models is considered. Section 8.2 presents the findings from the short-run equilibrium concentration model with different versions. Both logarithmic and linear functional forms are considered here. In section 8.3, the findings from the equilibrium concentration model are compared with an *ad hoc* version (variables taken from standard literature). Section 8.4 considers the findings from the disequilibrium model with both the linear and logarithmic specifications.

Next, the findings from conjectures models are presented in section 8.5. Finally, conclusions from both concentration and conjectures models are added in section 8.6.

8.2 Empirical Findings from Concentration Model with Different Versions

Here the findings from the three versions of equilibrium concentration models in Chapter 5 are discussed. These are Cowling-Watson version with Cournot behaviour, equation (5.9') and (5.9), Clarke-Davies version with different conjectures, equation (5.12') and (5.12), and the final version with heterogeneous product, equation (5.13') and (5.13). Both linear and logarithmic functional forms are estimated in each case.

8.2.1 The Results of Short-run Equilibrium Concentration Models

Table 8.1 presents the findings from equilibrium model in both linear and logarithmic functional form.¹ In each case, results are given with three regressions. Equation (5.9'), (5.12') and (5.13') are for Cowling-Watson version with Cournot behaviour, Clarke-Davies version with different conjectures and a heterogeneous product version, respectively, with linear functional form. Similarly, equation (5.9), (5.12) and (5.13) represent Cowling-Watson version with Cournot behaviour, Clarke-Davies version with different conjectures and a heterogeneous product version, respectively, with logarithmic functional form.

8.2.1.1 Linear Functional Form

For the linear functional form, in the Cowling-Watson version with Cournot behaviour (5.9'), all variables have expected signs but only NOF is significant at the one percent level, with an adjusted R^2 as 0.119. For Clarke-Davies version (5.12'), except CONJ, all variables are with expected signs. Again, only NOF is significant at the one percent level and with negative sign. Adjusted R^2 is 0.132. For the final version (5.13') with heterogeneous product, findings are same as Clarke-Davies version in terms of signs and significance levels, CPD is insignificant and opposite to the expected sign. Adjusted R^2 is 0.132 and same as Clarke-Davies version.

8.2.1.2 Logarithmic Functional Form

For the logarithmic functional form, in Cowling-Watson version with Cournot behaviour (5.9), all variables have with expected signs. NOF and CDR are significant at the one percent level and $ELAS_{own}$ is significant at the five percent level. The regression has an adjusted R^2 of 0.526. For Clarke-Davies version (5.12), NOF and CDR still have the

¹ Like the profit model, logarithmic functional form is more justified as discussed in Chapter 5. However, here both linear and logarithmic functional form are considered to keep parity with profit and conjecture models.

Table 8.1: Results of Equilibrium Concentration Model with Different Versions, 1984/85

Model Type	Equation Number	Intercept	NOF	ELAS _{own}	CDR	CONJ	CPD	R ² (adjusted)	F-ratio
Model 1' (Linear Functional Form)									
Cowling-Watson Version with Cournot Behaviour	(5.9')	0.118	-0.00009 ^a (4.36)	-0.020 (0.98)	-0.024 (0.62)	-	-	0.119	8.394 ^a
Clarke-Davies Version	(5.12')	0.115	-0.00008 ^a (3.30)	-0.002 (0.11)	-0.025 (0.69)	-0.004 (0.74)	-	0.132	6.500 ^a
A Version with Heterogenous Product*	(5.13')	0.119	-0.00008 ^a (3.14)	-0.001 (0.07)	-0.022 (0.58)	-0.004 (0.79)	-0.011 (1.13)	0.132	5.143 ^a
Model 1 (Logarithmic Functional Form)									
Cowling-Watson Version with Cournot Behaviour	(5.9)	-0.583	-0.450 ^a (8.60)	-0.133 ^b (1.80)	-0.171 ^a (3.78)	-	-	0.526	58.108 ^a

Table 8.1: Results of Equilibrium Concentration Model with Different Versions, 1984/85 (contd.)

Model Type	Equation Number	Intercept	NOF	ELAS _{own}	CDR	CONJ	CPD	R ² (adjusted)	F-ratio
Clarke-Davies Version	(5.12)	-0.660	-0.237 ^a (3.01)	0.556 ^a (3.70)	-0.086 ^a (2.52)	-0.575 ^a (3.96)	-	0.748	102.310 ^a
A Version with Heterogenous Product*	(5.13)	-0.660	-0.243 ^a (3.07)	0.552 ^a (3.67)	-0.088 ^a (2.55)	-0.571 ^a (3.93)	0.017 (0.58)	0.747	76.372 ^a

Note: H₈₄ as the dependent variable

The equation number for each version in bracket follows from the discussion of text in Chapter 5.

For the logarithmic functional form except CPD, all variables are in logarithmic form

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

F value at (3,98) degrees of freedom is 3.95 at the 0.01 level for F-test for the Cowling-Watson version of both the linear and logarithmic functional form.

F value at (4,97) degrees of freedom is 3.48 at the 0.01 level for F-test for the Clarke-Davies version of both the linear and logarithmic functional form.

F value at (5,96) degrees of freedom is 3.17 at the 0.01 level for F-test for the final version i.e. considering heterogeneous product of both the linear and logarithmic functional form.

*Ramsey's regression specification test statistic with power 3, i.e. RESET(3) = 24.939, RESET(3) = 1.930, respectively for the linear and logarithmic functional form model, follows F distribution where critical F is F_{0.01,3,93} = 3.95.

expected signs and significant at the one percent level but $ELAS_{own}$ and CONJ are significant at the one percent level, with opposite signs. Adjusted R^2 is 0.748. For the final version (5.13) with heterogeneous product, findings are same as the Clarke-Davies version in terms of signs and significance levels, CPD is insignificant here with expected positive sign. The value of adjusted R^2 is 0.747.

A comparison of the three versions, (viz. Cowling-Watson with Cournot behaviour, Clarke-Davies and the version with heterogeneous product) in both functional forms (linear and logarithmic), suggests that the Cowling-Watson type with Cournot behaviour concentration model in logarithmic functional form, (equation 5.13), yields the best results in terms of signs and significance levels of variables.

The standard diagnostic tests are performed for the final versions (i.e. 5.13' and 5.13) of concentration models with linear and logarithmic forms. Results are shown in Table 8.1. RESET test shows there is specification error for the linear functional form only.

Table 8.2 and 8.3 show the correlation matrix of variables for the linear (equation 5.13') and logarithmic version (equation 5.13), respectively. Also we check the multicollinearity with the auxiliary equation approach as discussed in Chapter 6, section 6.4.2.3. Except for H and NOF and CONJ and $ELAS_{own}$, there are low correlation coefficients among variables.

Table 8.2: Correlation Matrix of Variables for the Final Version of Concentration Model in Linear Functional Form

	H ₈₄	NOF	$ELAS_{own}$	CPD	CDR	CONJ
H ₈₄	1.000					
NOF	-0.363	1.000				
$ELAS_{own}$	-0.052	-0.107	1.000			
CPD	-0.169	0.211	-0.002	1.000		
CDR	-0.017	-0.156	0.051	0.081	1.000	
CONJ	-0.235	0.190	0.430	-0.009	-0.045	1.000

Table 8.3: Correlation Matrix of Variables the Concentration Model in Logarithmic Functional Form

	H ₈₄	NOF	ELAS _{own}	CPD	CDR	CONJ
H ₈₄	1.000					
NOF	-0.660	1.000				
ELAS _{own}	-0.056	-0.080	1.000			
CPD	-0.135	0.290	-0.053	1.000		
CDR	-0.017	-0.120	-0.030	0.068	1.000	
CONJ	-0.606	0.316	0.717	0.015	0.110	1.000

Note: All variables except CPD are in logarithmic form

8.3 Comparison of the Findings of Equilibrium Models with an *ad hoc* Version

To compare the findings from the oligopoly equilibrium concentration model, an alternative *ad hoc* version of concentration model is considered with variables suggested by the standard literature.² In Table 8.4, the findings from the equilibrium concentration model (for both linear and logarithmic functional forms) with the *ad hoc* version are reported. Equation (5.13') and (8.1') describe the equilibrium and an *ad hoc* version, respectively, in the linear functional form, while equation (5.13) and (8.1) describe the equilibrium and an *ad hoc* version, respectively, in the logarithmic functional form.

The *ad hoc* versions of concentration equation are as follows:

i) An *ad hoc* Version in Logarithmic Functional Form

$$\log H = \alpha_0 + \alpha_1 \log INVS + \alpha_2 \log MESCDR + \alpha_3 \log EXP + \alpha_4 \log IMP1 + CPD \quad (8.1)$$

+ ± - - +

² Again, like the *ad hoc* version of profit model, discussed in Chapter 7, section 7.4.3, the *ad hoc* version of the concentration model are also may not a complete one. Instead some standard variables are used from literature.

Table 8.4: Regression Results Comparing Oligopoly Based Equilibrium Concentration Model with an *ad hoc* Version,
H₈₄ as the Dependent Variable.

Model Type	Equilibrium Model	<i>ad hoc</i> Model	Equilibrium Model	<i>ad hoc</i> Model
Functional Form	Linear	Linear	Logarithmic	Logarithmic
Equation Number	(5.13')	(8.1')	(5.13)	(8.1)
NOF	-0.00008 ^a (3.14)	-	-0.243 ^a (3.07)	-
ELAS _{own}	-0.001 (0.07)	-	0.552 ^a (3.67)	-
CDR	-0.022 (0.58)	-	-0.088 ^a (2.55)	-
CONJ	-0.004 (0.79)	-	-0.571 ^a (3.93)	-
CPD	-0.011 (1.13)	-0.016 ^c (1.49)	0.017 (0.58)	-0.091 ^c (1.52)

Table 8.4: Regression Results Comparing Oligopoly Based Equilibrium Concentration Model with an *ad hoc* Version, H_{g4} as the Dependent Variable. (contd.)

Model Type	Equilibrium Model	<i>ad hoc</i> Model	Equilibrium Model	<i>ad hoc</i> Model
INVS	-	1.092 ^a (3.09)	-	0.450 ^a (3.39)
EXP	-	0.012 (0.38)	-	0.124 ^b (1.98)
IMP1	-	0.009 (0.44)	-	-0.013 (0.29)
MESCDR	-	0.413 ^c (1.34)	-	0.075 ^b (1.61)
GR	-	0.002 ^a (2.50)	-	-
EFFECT	-	0.0001 (1.13)	-	-
Intercept	0.119	0.049	-0.660	0.008
R ² (adjusted)	0.132	0.158	0.747	0.160

Note: For the logarithmic functional form except CPD, all variables are in logarithmic functional form

Equation numbers are from Chapter 5 and this Chapter

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.10 level using a one-tailed t-test.

ii) An *ad hoc* Version in Linear Functional Form³

$$H = \alpha'_0 + \alpha'_1 \text{ INVS} + \alpha'_2 \text{ MESCDR} + \alpha'_3 \text{ EXP} + \alpha'_4 \text{ IMP1} + \alpha'_5 \text{ CPD} + \alpha'_6 \text{ GROW} + \alpha'_7 \text{ EFFECT} \quad (8.1')$$

Here, investment (or capital) intensity (INVS), is a proxy for capital requirement entry barrier and is expected to have a positive effect on concentration. MESCDR is considered which takes into account the minimum efficient size as well as cost disadvantages of small firms. The expected sign is ambiguous. The sign for the consumer-producer dummy (CPD), a proxy for advertising intensity, coefficient on concentration is positive as discussed earlier (see also Comanor and Wilson (1967) and (1974)). The effect of export intensity (EXP) on concentration is expected to be negative as an increase in export intensity increases the market size, hence reduces concentration. The effect of import intensity (IMP1) on concentration is expected to be negative, as an increase in imports removes inefficient smaller firms, hence reduces concentration (see De Melo and Urata (1984)). The industry growth rate (GROW) has a positive effect on concentration in Martin (1979), but not in others (see Nelson (1960) and Shepherd (1964b)). A trade protection barrier (EFFECT) is included and a negative sign is expected on concentration. An increase in tariff reduces foreign competition, so the number of domestic firms expands and concentration falls.

For the linear functional form (equation 8.1') in the *ad hoc* version, INVS and GROW are significant at the one percent level, while MESCDR is significant at the ten percent level. CPD is with negative sign, i.e. opposite to expectation and significant at the ten percent level. Also EXP, IMP1 and EFFECT have opposite to expected signs, but are insignificant. The adjusted R^2 is 0.158 compared to 0.132 for the equilibrium model in equation (5.13').

For the *ad hoc* version with logarithmic functional form in equation (8.1'), INVS and MESCDR are significant at the one and five percent level, respectively. CPD and EXP are opposite to the predicted signs. IMP1 has the expected negative sign but is insignificant. The adjusted R^2 is 0.160 compared to 0.747 for the equilibrium model in equation (5.13).

³ Growth (GROW) on sales and protection (EFFECT) variables are added on R.H.S. only in the linear functional form. These two variables have negative values for a good number of industries hence no values can be calculated for the logarithmic functional form.

In summary, in terms of signs and significance level, neither of the *ad hoc* versions in Table 8.4 are very promising.

8.4 Empirical Findings from the Disequilibrium Concentration Model

Table 8.5 compares the results of the estimates from equilibrium (in terms of final versions) with disequilibrium model, when the speed of adjustment is constant across industries.⁴ The first two columns, i.e. equation (5.13') and (5.14') present the results for equilibrium and disequilibrium model respectively in linear functional form. Last two columns, i.e. equation (5.13) and (5.14.1) show the corresponding results for the equilibrium and disequilibrium model in logarithmic functional form. In all cases, Hg_4 is used as the dependent variable.

8.4.1 Linear Functional Form

For the linear functional form, in Table 8.5, except CONJ and CPD (both are insignificant), all variables have expected signs in both the equilibrium and disequilibrium model, i.e. in equation (5.13') and (5.14'), respectively. Only NOF is significant at the one percent level for both models. For the disequilibrium model, initial concentration (H_{77}) is significant at the one percent level with the expected positive sign. For disequilibrium model, the adjusted R^2 is 0.208, seven percent higher than the equilibrium model and the estimated annual adjustment coefficient of concentration is 16.45 percent.⁵

⁴ Most of the studies with changes in concentration, are based on a linear model assuming A constant adjustment coefficient. This neglects the possibility of variation in the speed of adjustment across industries. In this respect, both the speed of adjustment and the determinants of steady-state concentration should be examined (see Geroski and Masson (1987), Geroski, Masson and Shaanan (1987)). When the same sample is used to estimate a variable adjustment coefficient model in non-linear form, where some barriers to entry are considered as the determinants of adjustment factor, no major differences are found in results from the linear model results in Table 8.5.

⁵ Exactly same formula is used for the calculation of annual adjustment coefficient for concentration as in Appendix III. Instead of the profit, concentration is used.

Table 8.5: Regression Results Comparing Equilibrium and Disequilibrium Concentration Models, Hg₄ as the Dependent Variable.

Model Type	Equilibrium Model	Disequilibrium Model	Equilibrium Model	Disequilibrium Model
Functional Form	Linear	Linear	Logarithmic	Logarithmic
Equation Number	(5.13')	(5.14')	(5.13)	(5.14.1)
H ₇₇	-	0.284 ^a (2.87)	-	0.133 ^b (2.07)
NOF	-0.00008 ^a (3.14)	-0.00006 ^a (2.99)	-0.243 ^a (3.07)	-0.223 ^a (3.18)
ELAS _{own}	-0.001 (0.07)	-0.004 (0.21)	0.552 ^a (3.67)	0.535 ^a (3.58)
CDR	-0.022 (0.58)	-0.011 (0.32)	-0.088 ^a (2.55)	-0.080 ^a (2.84)
CONJ	-0.004 (0.79)	-0.003 (0.77)	-0.571 ^a (3.93)	-0.547 ^a (3.78)

Table 8.5: Regression Results Comparing Equilibrium and Disequilibrium Concentration Models,
H_{g4} as the Dependent Variable (contd.)

Model Type	Equilibrium Model	Disequilibrium Model	Equilibrium Model	Disequilibrium Model
Functional Form	Linear	Linear	Logarithmic	Logarithmic
Equation Number	(5.13')	(5.14')	(5.13)	(5.14.1)
CPD	-0.011 (1.13)	-0.009 (0.96)	0.017 (0.58)	0.015 (0.51)
Intercept	0.119	0.086	-0.660	-0.545
R ² (adjusted)	0.132	0.208	0.747	0.758
F-ratio	5.143*	6.570**	76.372*	65.381**
RESET(3)d	24.939 ^a	16.092 ^a	1.930	9.045 ^a

Note: For the logarithmic functional form except CPD, all variables are in logarithmic form

Equation Number follows from Chapter 5.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

*F value at (5,96) degrees of freedom is 3.17 at the 0.01 level for F-test for the equilibrium version of both logarithmic and linear functional forms.

**F value at (6,95) degrees of freedom is 2.96 at the 0.01 level for F-test for the dis-equilibrium version of both logarithmic and linear functional forms.

d For Ramsey's regression specification test statistic with power 3 critical F is $F_{0.01,3,93}=3.95$ for the equilibrium version and $F_{0.01,3,92}$ is also 3.95 for the disequilibrium model.

8.4.2 Logarithmic Functional Form

For the logarithmic functional form, in Table 8.5, except $ELAS_{OWN}$ and CONJ (both are significant at the one percent level), all variables have expected signs in both equilibrium and disequilibrium model, i.e. in equation (5.13) and (5.14.1), respectively. NOF and CDR are significant at the one percent level. CPD is insignificant in both models. Signs and significance levels for the disequilibrium version are similar to the equilibrium version. Initial concentration (H_{77}) is significant for the dis-equilibrium model at the five percent level with expected positive sign. The adjusted R^2 is only 0.01 percent higher for the disequilibrium model and the estimated annual adjustment coefficient of concentration is 12.35 percent.⁶

RESET test in Table 8.5 rejects the null hypothesis that there is no specification error for the disequilibrium version of concentration model for both the linear and logarithmic forms.

In summary, disequilibrium versions of the concentration model do not perform better in terms of signs and significance compared to the equilibrium versions. But initial concentration (H_{77}) is significant in both versions of disequilibrium model. Adjusted R^2 is also higher in both versions of disequilibrium model corresponding to the equilibrium one.

8.5 Empirical Findings of the Conjectures Model

Before discussing the empirical findings for the conjectures model, first a brief discussion regarding the values of the estimates of CONJ variable is included here. The estimates of conjectural variation variable for 102 industries lie between -1 to ∞ .⁷ The negative values of the conjectures variable imply competitive behaviour, its value equal to zero corresponds to Cournot behaviour, while a conjectures variable equal to $((1-H)/H)$ implies perfect collusion.⁸

Table 8.6 describes the findings for the conjectural variation model. Both linear and

⁶ Exactly the same formula is used for the calculation of annual adjustment coefficient for concentration as in Appendix IV. Instead of the profit, concentration is used.

⁷ CONJ variable is not restricted here for any particular model, instead these estimates cover a range of all possible models, minimum value is -0.940 and the maximum is 15.420.

⁸ From equation (4.4) $\psi = (1-H)/H$ implies $PCM=1/\epsilon$

logarithmic functional forms, i.e. equation (5.15') and (5.15), are considered here as there is no prior ground of supporting any particular functional form of this model. The first two columns are for the linear functional form and the last two columns are for the logarithmic functional form. In column 1 and 3, only the H index is considered as an independent variable.

8.5.1 Linear Functional Form

For the linear functional form, in column 1 of Table 8.6, H is found to be significant, but with a negative sign. Column 2 represents the full version of the conjectures model in equation (5.15') with linear functional form. The explanatory power is almost same as column 1, with only H as a control variable. The coefficients of STABLE, GROW and CPD variables are with expected signs and not significant even at the ten percent level. Also, the coefficients of H and IMP1 are significant at the one and five percent level, but opposite to the expected signs. Adjusted R^2 are similar here for column 1 and 2.

8.5.2 Logarithmic Functional Form

For the logarithmic version, in column 3 of Table 8.6, again H is significant, but with a negative sign. Column 4 represents the full version of the conjectures model i.e. equation (5.15). It does not add much in terms of explanatory power compared with column 3, where H is used as the only control variable. Adjusted R^2 has increased from 0.355 to 0.370. Here, as with the linear functional form, the coefficients of STABLE, GROW and CPD variables have the expected signs but are not significant even at the ten percent level. The coefficients of H and IMP1 are significant at the one and five percent level, but opposite to the expected signs.

The findings are more or less similar for both functional forms, except the model with the logarithmic functional form is superior in terms of explanatory power. The RESET test in

Table 8.6 rejects the null hypothesis that there is no specification error for the equilibrium conjectures model for both the linear and logarithmic forms.

Table 8.6: Findings from the of Conjectures Model in the Linear and Logarithmic Functional Form, 1984/85.

Functional Form	Linear	Linear	Logarithmic	Logarithmic
H	-8.329 ^b (1.82)	-8.372 ^b (2.11)	-0.876 ^a (7.52)	-0.875 ^a (7.52)
STABLE	-	0.455 (1.16)	-	0.095 (1.16)
GROW	-	-0.034 (0.56)	-	-0.0002 (0.02)
CPD	-	-0.233 (0.73)	-	-0.081 (1.09)
IMP1	-	0.977 ^b (1.75)	-	0.105 ^b (1.79)
Intercept	1.008	0.528	-1.202	-1.116
R ² (adjusted)	0.046	0.043	0.355	0.370
F-ratio	-	1.11	-	133.3*
RESET(3) ^d	-	17.034 ^d	-	21.107 ^d

Note: For the logarithmic functional form, all variables except dummies (i.e. CPD and STABLE) are in log forms.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

* F value at (5,97) degrees of freedom is 3.17 at the 0.01 level.

d Ramsey's regression specification test statistic follows F distribution where the critical F is $F_{0.01, 3, 93}=3.95$.

More noticeable, is the negative effect of H on CONJ, which is contrary to the expectation.⁹ Possible explanations for this perverse finding are : firstly, in the sample, there are 67 industries with CONJ between -1 and 0, 23 industries with CONJ between 0 and 1

⁹ According to the market power argument of the positive profit-concentration relationship, concentration increases collusion which results in higher profit. This result is found in the profit model, see Chapter 4.

and for 12 industries CONJ values are greater than 1.¹⁰ Therefore, most industries in the sample follow competitive behaviour. In this situation, from the findings we can not establish a positive association between H and CONJ. The sign of the estimated coefficient of H could be due to the simultaneity or measurement error for these two variables (H and CONJ).¹¹ In case of the existence of simultaneous relationships between these two variables, the OLS technique may be improper for estimating such relationships.¹²

8.6 Conclusions

In this chapter, the empirical findings from both concentration and conjectures models are considered. First a summary of findings from the concentration models is presented.

In this respect, both equilibrium and disequilibrium models of concentration (based on oligopoly) are considered. Firstly, some variables suggested by standard oligopoly equilibrium models are found to be significant in explaining concentration. In this respect, as with the profit model, there is evidence for the superiority of the logarithmic functional form to the linear one in terms of signs and significance levels of variables. Results are not always very strong in either case (in terms of significance and signs). The logarithmic functional form of the Cowling-Watson type model with Cournot behaviour version of concentration model yields the best results in terms of signs and significance, while Clarke-Davies version with higher explanatory power.

Secondly, the findings from the short-run equilibrium model (with both functional forms) are compared with the findings from the *ad hoc* versions. Here, for the *ad hoc* versions, some variables for barriers to entry appear to be significant in explaining

¹⁰ In Dixon and Gunther (1986), out of 20 Australian manufacturing industries, 8 industries are found to have negative conjecture values for 1968/69, 1977/78 and for 1972/73 with 7 negative values.

¹¹ It is important to note, a negative effect of CONJ on H is found in Chapter 8, section 8.2.1, which is also opposite to the predicted sign. CONJ estimates do not consider differentiated product and foreign competition. Also, it is based on average measures for each firm. Dixon and Gunther (1986) also find negative conjecture values and suggest one of the reason for getting negative values could be due to measurement error.

¹² This issue is considered in Chapter 9.

concentration. Also from the findings, the superiority of the oligopoly based concentration model can not be established compared to the *ad hoc* version.

Thirdly, the estimated annual rate of adjustment of concentration towards its equilibrium level is 16.45 percent for the model with linear functional form and 12.35 percent for the model with logarithmic functional form over a seven year period. The estimates of the annual speed of adjustment for both linear and logarithmic functional forms are higher than the studies of the U.S., U.K. and other countries (shown in Table 5.1).¹³

In summary, short-run concentration models are considered. Allowing for partial adjustment of concentration towards the equilibrium level, disequilibrium models are developed. In this respect, the whole range of variables used in previous studies are not considered here. Further work is warranted in this area with better measures of variables and considering a longer time period.¹⁴

Now, the findings from the conjectures model are summarised below. The structural characteristics, viz. the level and stability of concentration, growth in sales, product heterogeneity and import intensity are considered as determinants of conjectures.¹⁵

Stable market condition, growth in sales and product heterogeneity have the expected signs, but are insignificant in explaining conjectures (in both linear and logarithmic functional forms) with the sample of Australian manufacturing industries. Concentration and import intensity are significant for both linear and logarithmic functional forms, but have opposite to the predicted signs. In summary, the findings from the conjectures model are not very satisfactory.

Noticeably, there is no literature in this respect for Australian manufacturing, so the findings from our models can not be compared directly. Also, most of the overseas literature in this area is based on case studies for a single industry. Each case study may be associated with thousands of observations, but is similar to a single data point in a cross-section

¹³ The disequilibrium model here implies deviation from short-run equilibrium level of concentration, not from the long-run level.

¹⁴ In this respect, firm level data is necessary to measure the CONJ variable more accurately.

¹⁵ Some other factors, e.g. trade association between firms, low expectation of severe punishment etc can be found in literature.

analysis. This study is based on cross-industry data (and also CONJ variable for each industry is an average considering all firms together), so that it is not directly comparable.¹⁶

As mentioned early, this is only a first step for the Australian literature to explain conjectures with some industry structural variables. Availability of the data at the firm level would allow the researchers to do case studies as overseas. In this respect, a dynamic version of conjectures would be more appropriate compared to the short-run equilibrium model in explaining conjectures.

¹⁶ Most of the estimates of CONJ lies between -1 and 0 in the sample. Dividing the total firms in each industry into two groups: leader and followers and incorporating intra-industry competition or rivalry into the conjectures model may improve the results. Similar work has been done by Kwoka and Ravenscraft (1986) with Cowling-Watson model using the U.S. line of business data. With the four-enterprise data, it would be possible (though not accurately) to incorporate intra-industry effect into the model. However, the focus of the study is an inter-industry one, so industry structural variables are considered.

CHAPTER 9

SIMULTANEITY PROBLEM IN THE STRUCTURE - CONDUCT - PERFORMANCE RELATIONSHIPS: EMPIRICAL FINDINGS FROM THE MODELS

9.1 Introduction

Early studies of the profit-concentration relationship use a single-equation approach, assuming the existence of a unidirectional causality among structure-performance variables. A number of authors raise questions about the single-equation approach. According to them, a single-equation approach may result in biased and inconsistent estimates of the parameters. Other authors have suggested that the simultaneity bias is not so important and that the results of the single-equation studies are dependable. In Chapter 2, the literature regarding this debate is discussed.

In this chapter, in section 9.2, the models are presented as a simultaneous equation systems. Two systems of equations are considered. The first system of equations consists of three equilibrium equations for profits, concentration and conjectures, while the second system of equations includes two disequilibrium equations for profit and concentration and the equilibrium equation for conjectures. Also, the identification, rank and order conditions are checked for each system of equations. Comparison of the findings using the OLS technique with the 2SLS and 3SLS techniques is given in section 9.3. Major changes in findings for each model are discussed in this respect. In section 9.4, conclusions are added.

9.2 The System of Equations and Empirical Findings

In the following section, we consider two systems of equations.

9.2.1 System of Equations I

A three-equation simultaneous system is considered, where the equations are the final versions of short-run equilibrium profit, concentration and conjectures model, i.e. equation numbers (4.26), (5.13) and (5.15), respectively.¹ Here profit is determined by concentration and conjectures. Conjectures influences concentration and also is determined by concentration. These three focus variables viz, profit, concentration and conjectures are simultaneously determined into the equilibrium system. All equations are considered in logarithmic functional forms.²

$$\log (\text{GPMTO}) = \beta_0 + \beta_1 \log (\text{H}) + \beta_2 \log (\text{ELAS}_{\text{own}}) + \beta_3 \log (\text{CONJ}) + \beta_4 \text{CPD} + \beta_5 \log (\text{IMP1}) + \beta_6 \log (\text{INVS}) \quad (4.26)$$

$$\log \text{H} = \theta_0 + \theta_1 \log \text{NOF} + \theta_2 \log \text{ELAS}_{\text{own}} + \theta_3 \log \text{CDR} + \theta_4 \log \text{CONJ} + \theta_5 \text{CPD} \quad (5.13)$$

$$\log (\text{CONJ}) = \kappa_0 + \kappa_1 \log (\text{H}) + \kappa_2 \text{STABLE} + \kappa_3 \text{GR} + \kappa_4 \text{CPD} + \kappa_5 \log (\text{IMP1}) \quad (5.15)$$

Here, GPMTO, H and CONJ are treated as endogenous variables. So OLS estimation may gives biased and inconsistent estimates of parameters. In the following section, the rank and order conditions for identification are checked for each equation.³

With above equilibrium models, system I is estimated with the OLS, 2SLS and 3SLS techniques and the findings are described in Table 9.1, 9.2 and 9.3 of section 9.3.3.

¹ Same equation numbers are followed from previous chapters for both systems.

² The results with linear functional form of the equilibrium version of profit, concentration and conjecture model are more or less similar to the logarithmic form in terms of signs. Also in most cases, the logarithmic functional form are preferred on theoretical ground. Thus, to check simultaneity only the logarithmic functional form of each model is considered.

³ For estimation, an equation has to be just identified or over identified. This is discussed in Chapter 6.

9.2.2 System of Equations II

Also a second system of equations (system II) is considered, including disequilibrium versions of the profit and concentration model with the equilibrium conjectures equation as follows:

$$\log (\text{GPMTO}) = \beta'_0 + \beta'_1 \log (\text{H}) + \beta'_2 \log (\text{ELAS}_{\text{own}}) + \beta'_3 \log (\text{CONJ}) + \beta'_4 \text{CPD} + \beta'_5 \log (\text{IMP1}) + \beta'_6 \log (\text{INVS}) + \beta'_7 \text{GPMTO}_{77} \quad (4.27.1)$$

$$\log \text{H} = \theta'_0 + \theta'_1 \log \text{N} + \theta'_2 \log \text{ELAS}_{\text{own}} + \theta'_3 \log \text{CDR} + \theta'_4 \log \text{CONJ} + \theta'_5 \text{CPD} + \theta'_7 \text{H}_{77} \quad (5.14.1)$$

$$\log (\text{CONJ}) = \kappa'_0 + \kappa'_1 \log (\text{H}) + \kappa'_2 \text{STABLE} + \kappa'_3 \text{GR} + \kappa'_4 \text{CPD} + \kappa'_5 \log (\text{IMP1}) \quad (5.15)$$

Results of this system are reported in Table 9.1', 9.2' and 9.3' of section 9.3.3.

9.2.3 Checking Necessary and Sufficient Conditions for Identification of Each Equation

The discussion on rank and order condition is covered in Chapter 6 in section 6.4.1.3. In system of equations I, there are 3 endogenous variables (M) with 3 equations. The total number of exogenous (predetermined) variables (K) in the system is 8.

For the profit equation, number of endogenous variables (m) in this equation is 2. Number of exogenous variables in this equation (k) is 4. Here, $K - k = 4$ and $m - 1 = 1$. So $K - k > m - 1$ here and the rank of A matrix is 2 with non-zero determinant. Therefore, the profit equation is over identified.

For the concentration equation, number of endogenous variables (m) in this equation is 1. Number of exogenous variables in this equation (k) is 4. Here, $K - k = 4$ and $m - 1 = 0$. So

$K-k > m-1$ here and the rank of A matrix is 2 with non-zero determinant. Therefore, the concentration equation is over identified.

For the conjectures equation, number of endogenous variables (m) in this equation is 1. Number of exogenous variables in this equation (k) is 4. Here, $K-k = 4$ and $m-1 = 0$. So $K-k > m-1$ here and the rank of A matrix is 2 with non-zero determinant. Therefore, the conjectures equation is over identified.

Therefore, all three equilibrium models (in system of equation I) are over identified. The rank and order condition for the system of equations II (considering disequilibrium versions of the profit and concentration model with the equilibrium conjectures model) are also checked. Each equation is found to be over identified as with system I.

In the following section, for empirical purposes, the 2SLS and 3SLS techniques are applied to estimate each equation. Then, the findings are compared with our previous findings based on the OLS technique.

9.3 Estimation and Empirical Findings

Here, profit, concentration and conjectures equations are estimated separately.

9.3.1 Profit Equation

First we estimate the profit equation with the OLS and 3SLS techniques considering system of equation I and the same procedure is followed for system II.

9.3.1.1 Considering System of Equations I

Results of equilibrium profit model using the OLS, 2SLS and 3SLS techniques are reported in Table 9.1. Profits on sales (GPMTO) is used as the dependent variable. Only concentration

and conjectures variables are considered as endogenous variables, and the other variables are treated as exogenous.⁴

Results for the regressions using the OLS, 2SLS and 3SLS techniques are given in Column 1, 2 and 3 of Table 9.1. For the 2SLS and 3SLS estimations, except CPD, the coefficients of all variables are with expected signs and same as the OLS findings. However, all variables lose their significance. Therefore, simultaneity bias seems quite prominent into the profit equation.⁵

Table 9.1: Findings from the Equilibrium Profit Model Considering System I

	Column 1	Column 2	Column 3
	(OLS)	(2SLS)	(3SLS)
H	0.266 ^a (2.95)	0.319 (1.06)	0.333 (1.07)
ELAS_{own}	-0.330 ^a (3.46)	-0.393 (1.18)	-0.400 (1.16)
CONJ	0.286 ^a (3.16)	0.346 (1.10)	0.361 (1.12)
CPD	-0.018 (1.04)	-0.017 (0.91)	-0.016 (0.85)
IMP1	-0.015 (1.22)	-0.018 (0.82)	-0.019 (0.83)
INVS	0.073 ^b (1.84)	0.054 (0.47)	0.051 (0.43)
Intercept	-0.590	-0.582	-0.573
R²(adjusted)	0.362	-	-

Note: Except CPD all variables are in logarithmic functional form, considering equation (4.26)

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

⁴ Product differentiation and import intensity could be treated as endogenous, but both variables are found to be insignificant in the models as in other Australian studies, see Phillips (1978) and Ratnayke (1990).

⁵ In an earlier paper, Bhattacharya and Bloch (1997) find different results with 92 industries. Only concentration is treated as an endogenous variable, together with profits.

9.3.1.2 Considering System of Equations II

Results of the disequilibrium version of profit model using the OLS, 2SLS and 3SLS techniques are reported in Table 9.1'. Profits on sales (GPMTO₈₄) is used as the dependent variable. Again, only the concentration and conjectures variables are treated as endogenous variables, and the other variables are used as exogenous.

Table 9.1': Findings from the Disequilibrium Profit Model Considering System II

	Column 1	Column 2	Column 3
	(OLS)	(2SLS)	(3SLS)
GPMTO ₇₇	0.217 ^b (1.95)	0.219 ^a (2.75)	-0.819 (1.09)
H	0.258 ^a (2.94)	0.299 (1.24)	0.360 (0.74)
ELAS _{own}	-0.101 ^a (3.85)	-0.387 ^c (1.41)	-0.366 (0.68)
CONJ	0.288 ^a (3.26)	0.334 ^c (1.30)	0.350 (0.69)
CPD	-0.014 (0.86)	-0.014 (0.78)	-0.029 (0.91)
IMP1	-0.018 ^c (1.55)	-0.020 (1.07)	-0.007 (0.21)
INVS	0.060 ^b (1.67)	0.046 (0.48)	0.101 (0.50)
Intercept	-0.470	-0.463	-1.020
R ² (adjusted)	0.400	-	-

Note: Considering equation (4.27.1)

Except CPD all variables are in logarithmic functional form.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.10 level using a one-tailed t-test.

Results for the regressions using the OLS, 2SLS and 3SLS techniques are given in Column 1, 2 and 3 of Table 9.1'. For the 2SLS estimation, except CPD, the coefficients of all variables are with expected signs and same as the OLS findings. However, some variables

lose significance. $ELAS_{own}$ and CONJ are only significant at the ten percent level, and $GPMTO_{77}$ is significant at the one percent level.

For the 3SLS estimation, all variables except $GPMTO_{77}$, CPD are with expected signs but are insignificant.

In summary, a significant profit-concentration relationship can not be established using simultaneous equation techniques into the profit models. Signs are the same as with OLS findings both for Table 9.1 and 9.1' for most of the variables (except $GPMTO_{77}$ in the 3SLS estimation of the disequilibrium profit model). But, with the 2SLS and 3SLS techniques, significance vanishes for most of the variables. It should be noted that there is not much change in the magnitude of the estimated coefficients in general.

9.3.2 Concentration Equation

First, the concentration equation is estimated with the OLS and 3SLS techniques considering system of equation I then, same procedure is followed for system II.

9.3.2.1 Considering System of Equations I

Results for the equilibrium concentration model comparing using the OLS, 2SLS and 3SLS techniques are reported in Table 9.2. The Herfindahl index (H) is used as the dependent variable. Only conjectures is considered as an endogenous variable, and the other variables are treated as exogenous.

Results of the regressions using the OLS, 2SLS and 3SLS techniques are given in column 1, 2 and 3, respectively, of Table 9.2. Most importantly, for the 2SLS and 3SLS estimations, the coefficients of all variables are with expected signs. NOF is significant at the one percent level for both 2SLS and 3SLS techniques. CDR is significant at the five and one percent levels for the 2SLS and 3SLS techniques, respectively. CPD is positive and significant at the ten percent level only with the 3SLS technique. For the OLS technique, $ELAS_{own}$ and CONJ are with opposite to the expected signs and significant at the one

percent level. NOF, CDR and CPD are with expected signs, but only the first two variables are significant at the one percent level.

For the equilibrium concentration equation, simultaneous techniques (i.e. the 2SLS and 3SLS techniques) yield better results than the OLS estimation in terms of signs for all variables. The values of the estimated coefficients for most of the variables are greater with simultaneous estimation. Thus, simultaneity bias is prominent into the concentration equation.

9.3.2.2 Considering System of Equations II

Results for the concentration model using disequilibrium version of profit and concentration model and using the OLS, 2SLS and 3SLS techniques are reported in Table 9.2'. The Herfindahl index (H_{84}) is used as the dependent variable. Only conjectures is used as an endogenous variable, and the other variables are exogenous.

In Table 9.2', results of the regressions using the OLS, 2SLS and 3SLS techniques are given in column 1, 2 and 3 respectively. Again, for the 2SLS and 3SLS estimations, the coefficients of all variables are with expected signs. NOF is significant at the one percent level for both 2SLS and 3SLS techniques. CDR is significant at the one and five percent levels for the 2SLS and 3SLS techniques, respectively. CPD is positive and significant at the ten percent level only with the 3SLS technique. H_{77} has the expected positive sign for both the 2SLS and 3SLS techniques, but is significant at the one percent level only with the 2SLS technique. For the OLS technique, $ELAS_{OWN}$ and CONJ are with opposite signs and significant at the one percent level. NOF, CDR and CPD are with expected signs, but only first two variables are significant at the one percent level.

For the concentration equation of both for System I and II, the OLS results compare favourably with those from simultaneous techniques (i.e. the 2SLS and the 3SLS techniques). The 2SLS and 3SLS techniques perform better in terms of signs of coefficients (if not in terms of significance level always). For the 2SLS and 3SLS results, all variables are with expected signs as described in equation 5.13 and 5.14.1. In general, both for the equilibrium

and the disequilibrium model, simultaneity bias is prominent in the concentration equation and the simultaneous techniques produce results according to the expectations of oligopoly based model.

9.3.3 The Conjectures Equation

First the conjectures equation is estimated with the OLS and 3SLS techniques considering system I and the same procedure is followed for system II.

Table 9.2: Findings from the Equilibrium Concentration Model Considering System I

	Column 1	Column 2	Column 3
	(OLS)	(2SLS)	(3SLS)
NOF	-0.243 ^a (3.07)	-0.661 ^a (2.64)	-0.693 ^a (2.69)
ELAS _{own}	0.552 ^a (3.67)	-0.729 (0.97)	-0.731 (0.94)
CDR	-0.088 ^a (2.55)	-0.244 ^b (2.32)	-0.260 ^a (2.40)
CONJ	-0.571 ^a (3.93)	0.499 (0.80)	0.581 (0.91)
CPD	0.017 (0.58)	0.109 (1.24)	0.119 ^c (1.32)
Intercept	-0.660	-0.525	-0.475
R ² (adjusted)	0.747	-	-

Note: Considering equation (5.13)

Except CPD all variables are in logarithmic functional form.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.10 level using a one-tailed t-test.

Table 9.2': Findings from the Disequilibrium Concentration Model
Considering System II

	Column 1	Column 2	Column 3
	(OLS)	(2SLS)	(3SLS)
H ₇₇	0.133 ^b (2.07)	0.231 ^a (2.39)	0.091 (0.16)
NOF	-0.223 ^a (3.18)	-0.456 ^a (3.12)	-0.672 ^a (2.36)
ELAS _{own}	0.535 ^a (3.58)	-0.238 (0.51)	-0.710 (0.93)
CDR	-0.080 ^a (2.84)	-0.167 ^a (2.59)	-0.249 ^b (2.10)
CONJ	-0.547 ^a (3.78)	0.106 (0.27)	0.578 (0.91)
CPD	0.015 (0.51)	0.069 (1.17)	0.117 ^c (1.28)
Intercept	-0.545	-0.379	-0.393
R ² (adjusted)	0.758	-	-

Note: Considering equation (5.14.1)

Except CPD all variables are in logarithmic functional form.

H₈₄ is used as the dependent variable

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

c Indicates coefficient is significant at the 0.10 level using a one-tailed t-test

9.3.3.1 Considering System of Equations I

Results of the equilibrium conjectures model using the OLS, 2SLS and 3SLS techniques are reported in Table 9.3. The conjectures variable (CONJ) is used as the

dependent variable. Only concentration is treated as an endogenous variable, and the other variables are exogenous.

Results for the OLS, 2SLS and 3SLS regressions are given in column 1, 2 and 3 of Table 9.3. For the 2SLS and 3SLS estimations, the signs of coefficients and significance levels of all variables are same as the OLS results. For the OLS, 2SLS and 3SLS estimation techniques, the coefficients of STABLE, GROW and CPD variables are with expected signs but insignificant. The coefficients of H and IMP1 are significant, but with opposite to the expected signs.

Table 9.3: Findings from the Equilibrium Conjectures Model Considering System I

	Column 1	Column 2	Column 3
	(OLS)	(2SLS)	(3SLS)
H	-0.875 ^a (7.52)	-0.871 ^a (5.47)	-0.867 ^a (5.28)
STABLE	0.095 (1.16)	0.095 (1.20)	0.090 (1.09)
GROW	-0.0002 (0.02)	-0.0003 (0.03)	-0.001 (0.11)
CPD	-0.081 (1.09)	-0.081 (1.05)	-0.081 (1.02)
IMP1	0.105 ^b (1.79)	0.105 ^b (2.07)	0.099 ^b (1.90)
Intercept	-1.116	-1.113	-1.108
R² (adjusted)	0.370	-	-

Note: Considering equation (5.15)

STABLE, GROW and CPD are not in logarithmic functional form.

Figures in parentheses are White's heteroscedastic consistent t-ratios.

a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.

b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

at the one and five percent levels, respectively. Simultaneity bias is not very prominent in the conjectures equation.

9.3.3.2 Considering System of Equations II

Results of the conjectures model with the disequilibrium version of the profit and concentration models using the OLS, 2SLS and 3SLS techniques are reported in Table 9.3'. The conjectures variable (CONJ) is used as the dependent variable. Only concentration is treated as an endogenous variable, and the other variables are exogenous.

Results for the OLS, 2SLS and 3SLS regressions are given in column 1, 2 and 3 of Table 9.3'. For the 2SLS and 3SLS estimations, the signs of coefficients and significance levels of all variables are same as the OLS results. For the OLS, 2SLS and 3SLS estimation techniques, the coefficients of STABLE, GR and CPD variables are each with the expected sign, but insignificant. The coefficients of H and IMP1 are significant, but with opposite to the expected signs and significant at the one and five percent levels, respectively. Here also simultaneity bias is not very prominent in the conjectures equation.

Both for system i and II, the conjectures model yields similar results with all three estimation techniques (the OLS, 2SLS and 3SLS). None of the findings are not very satisfactory in terms of signs and significance levels.

9.4 Conclusions

There are strong a priori reasons to believe a simultaneity bias exists for some aspects of the SCP variables (see Chapter 2). This chapter has investigated the simultaneous nature of the relationships among profit, concentration and conjectures variable. In this respect, we consider two systems of equations are considered : i) system I consists of equilibrium models of profits, concentration and conjectures, ii) system II consists of disequilibrium version of the profit and concentration model with the equilibrium conjectures model. All models are estimated in logarithmic form. The 2SLS and 3SLS techniques are used for simultaneous

estimation and the findings are compared with the OLS results for each equation. The major findings can be summarised here.

Firstly, considering both system I and II, simultaneity is prominent for the profit models. The estimated coefficients are not much affected, but significance of the coefficients is generally lower with simultaneous estimation. Importantly, the positive relationship between concentration and profit is no longer significant with the 2SLS and 3SLS techniques.

Table 9.3': Findings from the Equilibrium Conjectures Model Considering System II

	Column 1	Column 2	Column 3
	(OLS)	(2SLS)	(3SLS)
H	-0.875 ^a (7.52)	-0.858 ^a (5.64)	-0.865 ^a (5.25)
STABLE	0.095 (1.16)	0.097 (1.21)	0.096 (1.16)
GROW	-0.0002 (0.02)	-0.0005 (0.05)	-0.0007 (0.07)
CPD	-0.081 (1.09)	-0.080 (1.04)	-0.081 (1.01)
IMP1	0.105 ^b (1.79)	0.105 ^b (2.06)	0.099 ^b (1.89)
Intercept	-1.116	-1.09	-1.11
R ² (adjusted)	0.370	-	-

Note: Considering equation (5.15)
STABLE, GROW and CPD are not in log form.
Figures in parentheses are White's heteroscedastic consistent t-ratios.
a Indicates coefficient is significant at the 0.01 level using a one-tailed t-test.
b Indicates coefficient is significant at the 0.05 level using a one-tailed t-test.

Secondly, considering both system I and II, simultaneity is prominent for the concentration model. In terms of signs, the 2SLS and 3SLS techniques perform better compared to the OLS technique. It should be noted, with the 2SLS and 3SLS techniques, the conjectures is positively related to concentration, according to the expectation of oligopoly models.

Finally, considering both system I and II, simultaneity is not prominent for the conjectures model. In terms of signs and significance, neither the OLS nor the 2SLS and 3SLS techniques yield satisfactory results.

CHAPTER 10

CONCLUSIONS AND FURTHER RECOMMENDATIONS

10.1 Introduction

The purpose of the study can be stated as twofold. First, some of the important aspects (viz. profits, concentration and conjectures of firms about their rivals) of the structure-conduct-performance paradigm are examined. Single equation models are derived from an oligopoly framework and estimated in context of Australian manufacturing. In this respect, no attempt has been made to include the whole range of variables mentioned in the literature. Also, some major issues commonly raised in structure-conduct-performance studies are examined with the industry sample. The models for the three aspects of the paradigm (viz. profits, concentration and conjectures) are specified in Chapters 4 and 5. Findings are summarised in Chapter 7 and 8. Also simultaneous relationships are estimated among the variables. The results from the simultaneous models are compared with those from single equation models in Chapter 9.

Secondly, for profit and concentration, a disequilibrium version is considered separately, where partial adjustment is allowed if profit (and concentration) deviates from its equilibrium level. In this respect, annual adjustment rates for profit (and concentration) are calculated from the model over a seven-year period.

In this concluding chapter, an overall summary of major findings is presented with some policy implications. This is done in section 10.2. Finally, in section 10.3, the limitations of the study are indicated with possible future directions for research in this area.

10.2 Summary of Major Findings and Policy Relevance

Having reviewed the fundamental aspects of the structure-conduct-performance paradigm with an overview of Australian manufacturing sector, models are developed for a closer

examination of each of its three links. In this respect, an oligopoly framework is considered. The major findings from Chapter 7, 8 and 9 are summarised below. The second part of this section discusses the policy relevance of the findings.

10.2.1 Summary of Major Findings

The overall summary of findings from the profit, concentration and conjectures models are presented in order.

The profit model is derived from an oligopoly framework, considering concentration, elasticity of demand, conjectures, product differentiation dummy, import intensity and capital intensity as the independent variables. For the short-run equilibrium profit model, a logarithmic functional form performs better in terms of significance level and explanatory power. Concentration is positive and significant at the one percent level with the logarithmic functional form, but is not significant with the linear functional form. Demand elasticity is with expected sign for the linear and logarithmic functional forms and is significant at the ten and one percent level, respectively. The conjectures variable is positive and significant at the one percent level in both functional forms. The product differentiation dummy is opposite to the expected sign with both linear and logarithmic functional form, but is not statistically significant. Import intensity is found to be insignificant with a negative sign in both linear and logarithmic functional forms. Capital-intensity also has the expected positive sign and is significant at the one and five percent level with the linear and logarithmic functional forms, respectively.

In summary, except for the product differentiation dummy, the profit model (particularly, with logarithmic functional form) fits well with the oligopoly framework for the industries included in the study. On the basis of the findings, we can infer a positive (and significant only with the logarithmic functional form) profit-concentration relationship in the Australian manufacturing sector. Also important to note, the positive and significant effect of the conjectures variable on profit with both linear and logarithmic functional form.

The findings from the profit model provide some support for the importance of major criticisms in explaining the structure-conduct-performance studies. First, the importance of

omitting the relevant explanatory variables is reflected in the findings. Overall explanatory power as well as the significance of concentration tends to increase when additional control variables are added into the profit equation.

Second, the choice of the measure of both dependent and independent variables is found to be important in explaining the structure-conduct-performance studies. Firstly, with the gross margin on value added as the profit measure, the significance of demand elasticity and conjectures is reduced and capital-intensity is no longer significant. Also, only with this measure of profit, import-intensity is negative and significant at the one percent level. Secondly, when the four-firm concentration ratio is used instead of Herfindahl-index, concentration is no longer significant in explaining profit although still with a positive sign.

Third, the findings also suggest that aggregation bias may affect the structure-performance relationship. Dividing the full sample into four groups according to the lowest value of coefficient of variation of firm size (an index of aggregation), the findings show that the profit-concentration relationship is strongest for the sub sample with lowest value of coefficient of variation of firm size. The estimated coefficients for this sub sample provide a close fit to the magnitudes predicted by the Cowling-Watson type oligopoly model.

Finally, there is some evidence that the presence of product differentiation may affect the structure-performance relationship. The profit-concentration relationship is found to be stronger for consumer goods industries compared to producer goods industries.

To compare the results from the hypothesised profit model, an *ad hoc* version of the model is developed. The findings support the superiority of the theory-based profit model compared to the *ad hoc* version. Concentration is still positive, but insignificant, in explaining profit in the *ad hoc* version.

Disequilibrium versions of the profit model, with both linear and logarithmic functional forms, are developed considering deviation of profit from its equilibrium level. A constant partial adjustment rate of profit is considered. The disequilibrium version with the logarithmic functional form performs better than the corresponding linear form. All variables, except the product differentiation dummy, are found to have expected signs and are significant at least at the ten percent level. The initial profit is significant with the

expected positive sign. The annual adjustment rate of profit is just over 11 percent (in the logarithmic specification).

The overall results from the profit models show that the relationship between profits and concentration is positive (except the linear version of the disequilibrium model) and, in most of the cases, significant across the sample of manufacturing industries. The variables suggested by the oligopoly framework seem to be significant in explaining profit, except that the import variable is insignificant in explaining profits in most of the cases.

The major findings from the concentration models are presented here. The concentration level as derived from oligopoly equilibrium is determined by number of firms, elasticity of demand, product differentiation dummy, cost disadvantage ratio and conjectures. For the equilibrium versions (viz. Cowling-Watson version with Cournot behaviour, Clarke-Davies version with different conjectures among firms and a version with heterogeneous product), both the linear and logarithmic functional forms are considered. Conjectures and product differentiation dummy are always opposite to the expected signs. All other variables are with expected signs (except elasticity of demand in the logarithmic functional form for the Clarke-Davies version and the version with heterogeneous product). Among all cases, the logarithmic functional form of the Cowling-Watson type model with Cournot behaviour yields the best results in terms of signs and significance.

As with the profit model, disequilibrium versions of the concentration model are considered, with both linear and logarithmic functional forms. A constant partial adjustment rate of concentration is considered. Except for the elasticity of demand and conjectures (which are with opposite to the expected signs and significant), in terms of signs and significance, the disequilibrium version in the logarithmic functional form performs better. Initial concentration is significant with the expected positive sign. The estimated annual adjustment rate of concentration is just over 12 percent (following logarithmic specification).

Unlike the profit model, concentration models do not always perform well in terms of signs and significance. In terms of functional specification, for the concentration model as with the profit model, the logarithmic functional form performs better compared to the linear one.

The findings from the equilibrium conjectures model are considered here. Both the linear and logarithmic functional form are used. Conjectures is determined by levels and stability of concentration, growth in sales, product differentiation and import intensity. Among these, only stable market condition, growth in sales and product differentiation have the expected signs, but they are each found to be insignificant in explaining conjectures for both linear and logarithmic functional forms.

Finally, the models are used as a simultaneous equation system. Two systems of equations are considered. System I consists the equilibrium models of profit, concentration and conjectures. System II consists of disequilibrium versions of profit and concentration along with the equilibrium conjectures model. Each equation, viz. profit, concentration and conjectures is re-estimated with the 2SLS and 3SLS techniques within system I and II. In the profit equation, concentration and conjectures are treated as the endogenous variables. In the concentration equation, conjectures is treated as an endogenous variable. Finally, in the conjectures equation concentration is treated as an endogenous variable. The findings suggest that simultaneity bias is prominent for the profit and concentration models.

In profit models, all variables (except the sign of initial profit with the 3SLS technique in system II) have the same signs as the OLS results. However, the significance level is reduced (or completely lost) for most of the variables. Most importantly, a significant positive relationship can not be established between concentration and profit using the 2SLS and 3SLS techniques.

In concentration models, all signs are according to the expectation and significant for most of the variables with the 2SLS and 3SLS techniques compared to the OLS technique. It should be noted, with the 2SLS and 3SLS techniques, the conjectures and product differentiation dummy are positively related to concentration, which is according to the expectation of the oligopoly model.

Simultaneity is not prominent for the conjectures model. In terms of signs and significance, neither the OLS nor the 2SLS and 3SLS techniques yield satisfactory results.

In summary, there is some evidence of simultaneous relationships among the structure, conduct and performance variables in the study.

10.2.2 Policy Implications

Most of the work in this study has theoretical relevance rather than policy application. This is because, the study establishes links among the structure, conduct and performance variables with the help of well-known oligopoly models and the findings help to understand the role of market processes. The following discussion tries to indicate some policy relevance from the major findings of the study.

It is quite common in industrial organisation literature to find that the empirical findings from structure-conduct-performance studies have implications for competition policy. A strong positive relationship between concentration and profit tends to support vigorous antitrust policies. In Chapter 3, it was noted that different sorts of anti-competitive practices are quite common in Australia with high level of concentration in manufacturing. The study establishes, a positive (and strong in most cases) relationship between profit and concentration. Looking at the findings from the profit models, one could infer that there is some support for introducing antitrust policy.¹

Secondly, the findings from the profit model can not establish the importance of the import variable in the performance of manufacturing sector. Domestic structural and behavioural factors appear to be significant in explaining profit compared to the foreign variable. This suggests domestic restructuring may be more important than foreign trade policies to explain the competitiveness in manufacturing industries.

Some of the structural and demand characteristics (e.g. number of firms, elasticity of demand and cost disadvantages of the small firms) are generally important in explaining concentration of industries.

Both from the profit and concentration models, disequilibrium versions show that the adjustment process takes some time.

¹ Although in the conjecture model, a negative relationship is found between concentration and conjecture. We suspect there is some specification problem in the conjecture model. This is clear from the RESET test, which shows specification error both for the linear and logarithmic specifications.

10.3 Limitations and a Look at the Future

This study is restricted in some aspects. Also, the approach and set of included variables are different than in most of the Australian literature. The following sections cover the limitations of the study with some indications of further work in this area.

10.3.1 Limitations of the Study

The study employs an inter-industry, cross-section approach to examine the interrelationships among industry structure, conduct and performance variables based on oligopoly theory. Major limitations of the study are identified here. These are divided into two groups: i) limitations due to underlying assumptions of the models and ii) limitations due to data unavailability.

First, limitations due to underlying assumptions of the models are pointed out in the following paragraphs.

The study includes variables suggested by Cowling-Watson type studies, which aims at driving 'ad hoc' out of the structure-conduct-performance studies. It is quite possible that some structural elements with potential explanatory power have not been included in the profit, concentration and conjectures equations.

One major limitation (perhaps the more correct word is criticism) of the study is the nature of the hypothesised model, which is based on short-run static oligopoly theory. Examining short-run profits may reveal very little about the degree of competition in an industry, as for all market structures short-run profit can be either positive or negative. In fact, the Cowling-Watson model is often criticised, along with the whole conjectural variations literature, as being an attempt to squeeze dynamic intuition into a static model.² Any relationship uncovered using short-run profits is likely to be unstable over time. Long-run dynamic analysis might be more appropriate.

² The critics may suggest developing a model of dynamic competition that explicitly considering entry or exit rather than a static one-period model. The argument is true, but does not match with the spirit of the thesis.

In defining conjectures of firms, conjectural variations models are considered. These models are arbitrary and multi-period versions are implausible (discussed in Chapter 7). Collusive outcomes are more common in markets which exist for an indefinite period rather than a short period of time. The specified short-run conjectures model may not be a proper one in explaining conjectures and hence profits and concentration (as these three variables are interlinked).

Secondly, the lack of data for measuring variables is a major source of limitation in industrial organisation research in Australia. This has been emphasised by several researchers from time to time (see, Round (1976) and Phillips (1978)). The absence of data at the desired level of disaggregation is a major limitation, e.g. the estimates of the price elasticity of demand in the study are mostly more aggregated than the four-digit level (the aggregation level for the other variables in the study), as these are the only available estimates to date for the Australian manufacturing industries. In some cases, proxies are considered instead of relevant variables, e.g. there is doubt that a consumer-producer dummy can capture the degree of product differentiation accurately. Advertising is considered both as a source and symptom of product differentiation, some measure of advertising intensity might be more appropriate as a proxy for product differentiation.

The measure of the conjectures variable is derived from firms' gross profit margins and shares of firms. In the absence of individual firm data, average values of four-enterprise groups are considered. Indirect estimates of conjectures might have spurious relations with profits and concentration. This is handled formally with the simultaneous equation techniques. Also when measuring conjectures, product heterogeneity and foreign competition are not taken into account.³

Finally, it is noted early that one limitation of this study is that it employs cross-sectional data for a single year for the equilibrium versions and for two periods (with a seven year lag from 1977/78 to 1984/85) for the disequilibrium versions. A short-run model can be affected with transitory changes. Longer time series data (at the industry and /or firm

³ Stalhammar (1991) considers these in measuring implicit collusion for the Swedish manufacturing industries.

level) are desirable to provide a stronger basis to evaluate market processes and structure-conduct-performance relationships.

10.3.2 Future Directions

This study includes only three aspects of the structure-conduct-performance paradigm, viz. profits, concentration and conjectures, and employs only variables which are suggested by the Cowling-Watson type model. One possibility for further work in this direction is to include trade equations (particularly, with import intensity, tariffs and foreign investment), considering the proper specification of these equations.

In the study, naive assumptions are made about entry possibility, assuming the number of firms are fixed (or exogenous) in the industry. Entry theory has undergone substantial development recently. Subsequent work in this area may highlight the crucial role of entry to explain the competitive process (both in static and dynamic senses).

The conduct of firms should be strongly considered in determining the industry structure-performance relationship. Sawyer (1981) argues that the paradigm emphasises the explanatory powers of industry structure rather than the nature of firms in the industry. In this respect, conduct variables should include intra-industry rivalry among an industry's leading firms. Also conjectures is nothing but the responses of other firms to a change in quantity (or price) by the individual firm. It would be worth looking at some determinants, e.g. physical and financial capacity of the rivals, legal framework of firms, to explain conjectures.

Also in future studies, more extensive examination of the virtues and defects of the conjectures variables used in the study may contribute knowledge towards the literature.⁴ Regressing gross profit margin against enterprise group within in each industry to identify the conjectures variables as an estimated parameter could be a possible way of tackling the

⁴ In Chapter 6, while defining conjectures some limitations are mentioned already. I would like to indicate one more possible limitation. In finding conjectures we have used elasticity data (which are in most cases aggregated). Therefore finding the conjectures values at the four-digit level using the aggregated elasticity data may create substantial bias. We suspect this bias in the values of conjectures, as in most cases these values reflect competitive behaviour. Yet, collusive behaviour is quite common for the Australian manufacturing sector as is mentioned in Chapter 3.

spurious relation (if any) problem. This might be an alternative approach in addition to the current measure of conjectures (which is considered in this study) and a direction towards future research.

Finally, one major defect that Phillips (1978) noted in his Ph.D. thesis nearly twenty years back still remains in Australian industrial organisation research. This is the limited availability of the Australian data specially at the firm level. In overseas literature, it is becoming increasingly common to use detailed data sets at the level of the firm or product line in analysing market processes. The availability of published data at the firm level for a reasonably large number of industries for a certain time period will greatly assist Australian research in this area.

APPENDIX IA: DATA SOURCES AND DEFINITION OF VARIABLES

Variables	Definition	Data Source
GPMTO	'Value added minus intermediate expenses minus wages' divided by sales.	1
GPMVA	'Value added minus intermediate expenses minus wages' divided by value added.	1
GPMTO ₇₇	Same as GPMTO ₈₄ using 1977/78 data.	1
H	Herfindahl index of concentration in terms of sales for 1984/85.	1
H ₇₇	Same as above with 1977/78 data	1
CR4	Industry sales accounted by the top 4 firms divided by total industry sales for 1984/85	1
CONJ	Formula described in Section 6.2.3, an implicit measure of collusion, 1984/85	1
ELAS _{own}	Market price elasticity of demand, estimates are taken from data source 3	3
INVS	The average of investment over sales for 1977 to 1985.	5
IMP1	Import divided by sales plus import minus exports for 1984/85.	5

CPD	=0 for Producer Goods =1 for Consumer Goods	2
STABLE	=1 if the absolute value of the change in H-index between 1977 and 1984 is no more than 0.05 points. =0 otherwise.	1
GROW	'Turnover of 1984 less turnover of 1977' divided by turnover of 1977	1
MES	Described in Section 6.2.10.1, 1984/85.	1
CDR	'Average value added per worker for the rest of the firms over the average value added per worker for the large firms' for 1984/85.	1
MESCDR	MES over CDR	1
EXP	Export divided by sales for 1984/85.	5
EFFECT	Estimates of effective rates of protection, 1984/85.	4

APPENDIX IB: DESCRIPTIVE STATISTICS OF THE VARIABLES USED IN THE STUDY

Variables	Mean	Standard Deviation	Maximum	Minimum
GPMTO	0.127	0.036	0.282	0.069
GPMVA	0.335	0.095	0.638	0.153
GPMTO ₇₇	0.193	0.044	0.349	0.058
H	0.092	0.058	0.263	0.007
H ₇₇	0.101	0.060	0.242	0.011
CR4	0.425	0.332	0.994	0.0002
CONJ	0.219	2.089	15.421	-2.294
ELAS _{own}	0.416	0.255	0.774	0.072
INVS	0.029	0.018	0.116	-0.007

APPENDIX IB (contd.)

Variables	Mean	Standard Deviation	Maximum	Minimum
IMP1	0.245	0.235	0.865	0.0001
GROW	2.244	4.115	21.582	-0.783
MES	0.138	0.176	1.200	0.009
CDR	0.076	0.061	0.240	0.008
MESCDR	0.001	0.002	0.010	0.47×10^{-7}
EXP	0.145	0.137	0.368	0.003
EFFECT	37.951	53.781	250.00	-18.000

APPENDIX II: DESCRIPTION OF THE INDUSTRIES INCLUDED IN THE STUDY

ASIC	DESCRIPTION
2115	Meat
2116	Poultry
2117	Bacon Ham & Smallgoods nec
2131	Fruit Products
2132	Vegetable Products
2140	Margarines Oils Fats nec
2151	Flour Mill Products
2153	Cereal Foods & Baking Mixes
2161	Bread
2162	Cakes & Pasteries
2163	Biscuits
2171	Raw Sugar
2173	Confectionary & Cocoa
2174	Processed Seafoods
2175	Prepared Animal & Bird Food
2176	Food Products nec
2185	Soft Drinks Cordials & Syrups
2186	Beer
2188	Wine & Brandy
2190	Tobacco Products
2343	Man-Made Fibres & Yarns
2344	Man-Made Fibre & Broadwovens
2345	Cotton Yarns & Broadwoven Fabrics
2346	Worsted Yarns & Broadwoven Fabrics
2347	Woolen Yarns
2348	Narrow Woven & Elastic Textiles
2349	Textile Furnishing
2351	Household Textiles
2352	Textile Floor Coverings
2353	Felt & Felt Products
2354	Canvas & Assoc Products
2355	Rope Cordage & Twine
2441	Hoisery
2442	Cardigans & Pullovers
2451	Mens Trousers Work Cloths etc
2452	Mens Suits & Coats
2454	Foundation Garments
2456	Headware & Clothing nec
2460	Footwear

APPENDIX II (contd.)

ASIC	DESCRIPTION
2533	Veneers & Manufactured Wood Boards
2535	Wooden Structural Fittings & nec
2536	Wooden Containers
2538	Wood Products nec
2542	Matresses (Non-Rubber)
2631	Pulp Paper etc
2635	Paper Products nec
2645	Printing Services nec
2753	Synthetic Resins & Rubber
2762	Paints
2763	Pharm & Vet Products
2764	Pesticides
2765	Soap & Detergents
2766	Cosmetics & Toilet Preparations
2767	Inks
2770	Petroleum Refining
2780	Petroleum & Coal Product nec
2850	Glass & Glass Products
2861	Clay Bricks
2862	Refractories
2863	Ceramic Tiles & Pipes
2864	Ceramic Goods nec
2871	Cement
2884	Non-Metalic Mineral Products
2942	Iron Castings
2962	Non-Fer Met nec Rolling etc
3142	Architectural Almin Products
3151	Metal Containers
3161	Cutlery & Hand Tools nec
3163	Nuts Bolts etc
3165	Non-Fer Gas & Water Fittings
3166	Boiler & Plate Work
3167	Metal Blinds & Awnings
3232	Motor Vehicle Bodies Caravans etc
3233	Motor Vehicle Instruments & Elect nec
3242	Boats
3243	Railway Locos & Rolling Stock
3244	Aircraft
3245	Transport Equipment nec
3341	Photo & Optical Goods
3343	Measuring Scientific etc Equipment

APPENDIX II (contd.)

ASIC	DESCRIPTION
3351	Radios TVs & Audio Equipments
3352	Electronic Equipment nec
3353	Refrigerators & Household Appliances
3354	Water Heating System
3355	Electric & Telephone Cables
3357	Electric Machine & Equipment nec
3361	Agricultural Machinery
3362	Construction Machinery
3363	Materials Handling Equipments
3364	Wood & Metal Working Machinery
3365	Pumps & Compressors
3366	Commercial Space Heating & Cooling Equipment
3367	Dies Saw Blades etc
3369	Industrial Machinery nec
3451	Leather & Fur Tanning etc
3452	Leather & Leather Sub nec
3461	Agricultural Machinery
3462	Rubber Products nec
3484	Signs & Advertising Displays
3485	Sporting Equipment
3486	Writing & Marking Equipment
3487	Manufacturing nec

APPENDIX III: CALCULATION OF THE ANNUAL ADJUSTMENT OF PROFIT FOR THE LINEAR MODEL

Calculation of μ (Annual Adjustment Rate of Profits)

$$\pi_t = \pi_{t-1} + \mu'(\pi_t^* - \pi_{t-1})$$

$$\pi_t = (1 - \mu')\pi_{t-1} + \mu'\pi_t^*$$

$$\pi_t = \pi_{t-2} + \mu'(\pi_t^* - \pi_{t-2})$$

$$\pi_t = \pi_{t-2} + \mu'(1 - \mu')(\pi_t^* - \pi_{t-2}) + \mu'(\pi_t^* - \pi_{t-2})$$

by analogy,

$$\pi_t = \pi_{t-n} + \mu'[1 + (1 - \mu') + (1 - \mu')^2 + \dots + (1 - \mu')^{n-1}](\pi_t^* - \pi_{t-n})$$

$$\pi_t - \pi_{t-n} = \mu' \sum_{i=1}^n (1 - \mu')^{i-1} (\pi_t^* - \pi_{t-n})$$

as $n \rightarrow \infty$

$$\pi_t - \pi_{t-n} = \mu' \left[\frac{1}{1 - (1 - \mu')} \right] (\pi_t^* - \pi_{t-\infty}) = (\pi_t^* - \pi_{t-\infty})$$

$$\pi_t - \pi_{t-n} = [\pi_t - \pi_{t-\infty}] - [\pi_{t-n} - \pi_{t-\infty}]$$

$$\pi_{t-n} - \pi_{t-\infty} = \mu' \left[\sum_{i=n+1}^{\infty} (1 - \mu')^{i-1} \right] (\pi_t^* - \pi_{t-\infty}) = (1 - \mu')^n \left[\mu' \sum_{i=1}^{\infty} (1 - \mu')^{i-1} \right] (\pi_t^* - \pi_{t-\infty}) = (1 - \mu')^n (\pi_t^* - \pi_{t-\infty})$$

$$\pi_t - \pi_{t-n} = [\pi_t - \pi_{t-\infty}] - [\pi_{t-n} - \pi_{t-\infty}] = [1 - (1 - \mu')^n] (\pi_t^* - \pi_{t-\infty}),$$

$$\pi_t - \pi_{t-n} = [1 - (1 - \mu')^n] (\pi_t^* - \pi_{t-n})$$

$$\text{Let, } X = 1 - (1 - \mu')^n$$

$$\pi_t = X(\pi_t^* - \pi_{t-n}) + \pi_{t-n}$$

$$\pi_t = X\pi_t^* + (1 - X)\pi_{t-n}$$

$$\text{or, } 1 - X = (1 - \mu')^n$$

$$\mu = 1 - (1 - X)^{1/n}$$

Using the relationship above, $(1 - X) = 0.215$ and therefore $\mu' = 1 - (0.215)^{1/7} = 0.197$ (about 19.7 %).

Appendix IV: Calculation of Annual Adjustment Rate of Profits for the Logarithmic Model

$$\frac{\pi_t}{\pi_{t-1}} = \left(\frac{\pi_t^*}{\pi_{t-1}} \right)^\mu$$

$$\frac{\pi_t}{\pi_{t-n}} = \left(\frac{\pi_t}{\pi_{t-1}} \right) \left(\frac{\pi_{t-1}}{\pi_{t-2}} \right) \dots \left(\frac{\pi_{t-n+1}}{\pi_{t-n}} \right)$$

$$\frac{\pi_{t-j}}{\pi_{t-j-1}} = \left(\frac{\pi_{t-j}^*}{\pi_{t-j-1}} \right)^\mu$$

$$\frac{\pi_t}{\pi_{t-n}} = \left(\frac{\pi_{t-n+1}}{\pi_{t-n}} \right)^{n\mu} = \left(\frac{\pi_t^*}{\pi_{t-n}} \right)^{n\mu} \text{ when } \pi_t^* = \pi_{t-j}^* \text{ for all } j$$

Let $X = n\mu$, Taking logarithms yields

$$\log \pi_t = n\mu \log \pi_t^* + (1 - X) \log \pi_{t-n}$$

For Logarithmic model, using relationship above, $(1 - X) = 0.217$ with $X = 0.783$ and therefore

$$\mu = X / n = 0.783 / 7 = 0.112 \text{ (11.2\%)}$$

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¹ The number for the data sources should be read for the data Appendix IA

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PUBLICATIONS/PRESENTATIONS FROM THIS THESIS

Journal Paper

Bhattacharya, M and Bloch, H. (1997), *Specification and Testing the Profit-Concentration Relationship in Australian Manufacturing*, *Review of Industrial Organisation*, (forthcoming).

Discussion Papers

Bhattacharya, M and Bloch, H. (1995a), *Specification and Testing the Profit-Concentration Relationship in Australian Manufacturing*, Discussion Paper 1995-02, Department of Economics, The University of Tasmania, Australia.

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